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SCIENCE IN MUSIC

By Professor CARL E. SEASHORE

THE STATE UNIVERSITY OF IOWA

MUSIC draws upon a number of basic sciences, such as mathematics, physics, physiology, anatomy, genetics, anthropology and general psychology, in the light of prevailing musical theory and practice. It has become the function of the new applied science, the psychology of music, to integrate all these contributions and fit them as a unified function into the theory and practice of music and to initiate specifically designed experiments for the solving of musical problems. The initiative has been taken by psychologists; but as knowledge of the scientific aspects becomes a part of artistic creation and skill, this work of integration will be taken over more and more by musicians, and the distinction between the scientist and the artist will tend to disappear.

On the occasion of a football game at the University of Oklahoma in 1939, I saw seventy-seven marching bands on parade. This represented only a section of the state, and the dust bowl state at that. It meant that music is being taught in the public schools of that state on a surprisingly large scale. Out of these popular bands in showy uniform will come a host of musicians of all kinds and degrees. Music is in the public schools to stay on a large scale. Music in America is in the air, literally and figuratively.

In the last ten years, the State University of Iowa, as one of the American universities which have taken cognizance of this problem, has conferred twelve doctor of philosophy degrees and one hundred ninety-seven master of arts degrees in music. The master of arts is coming to be required of all high-school music teachers. From kindergarten up to the graduate

school, music has been taken in with the three r's and their derivatives. As a result we have such relatively new terms as "music educator" and "musicology."

For a certificate to teach music, the candidate must ordinarily be certified for courses in general psychology and educational psychology; and a third requirement, the specific psychology of music, is fast coming in through our teacher-training schools.

In recent years the development of the Acoustical Society of America has brought about a revolution in musical thinking. Research in musical acoustics is being put on a rigidly scientific basis and is making great progress. There is an awakening interest in what is called musicology, the science of music, which has many branches, one of the most active of which is the psychology of music.

In view of this new demand and the new possibilities of a scientific approach to music and scientific foundations for musical education and musical theory in preparation for the teaching and study of music, it is time to inquire, "What can psychology do for music?"[1]

From the time of Aristoxenines and Pythagoras, there have been two attitudes toward music: one is the purely impressionistic attitude of the musician who is not interested in explanations but merely in results as judged by his unaided ear and speculative mind; the other is that of the scientific inquirer, like Pythagoras, who asked, for example, "What are the reasons for the musical scale, and what are its limitations?" The first is the easy and laissez-faire attitude; the second is a critical and scientific attitude which made no great progress until the beginning of the renaissance. Its first prominent organizer, Helmholtz, digested accumulated material from all sources and made fundamental contributions through his laboratory researches, discussed in his epoch-making volume, *Die Tonempfindungen,* in 1862.

Psychology as an experimental science had its beginning only fifty years ago, and in the first half of that period, showed no interest in music. Thus the scientific approach to the understanding and mastery of music is relatively new, and antiscientific musicians are still with us in large numbers.

Psychology gives us a workable insight into the nature of the musical mind and thus lays foundations for the classification of events in musical experience and behavior and for the development of a scientific musical terminology.

The psychology of music is the science of musical experience and behavior. A general knowledge of the structure and function of the musical organism is therefore one of the first requirements in a scientific approach to the study and mastery of music. It helps the student understand what specific features he is dealing with in learning and performing and furnishes the essential basis for the orderly arrangement of observed facts. For example, we learn that the sound wave as the exclusive source of musical tones has only four basic variables; namely, frequency, intensity, duration and wave form. And on the basis of this it has been found that the musical organism must have four corresponding capacities for hearing all music, namely, the sense of pitch, the sense of loudness, the sense of time and the sense of timbre. This conception simplifies the understanding of the nature and function of the musical mind in that each of these four basic functions apears in such complex musical forms as harmony, melody, dynamics, rhythm, volume and tone quality. It has been shown that all of musical memory, musical imagination, musical thought, musical feeling and emotion, musical action and musical composition may be expressed in these four terms. Thus the classification vastly simplifies the task of the musician and makes the problems of appreciation and performance concrete and specific. The understanding and description of musical design in composition, all the forms of musical expression of feeling, all the techniques in ear-training, all the analyses of musical appreciation, all deviations from the true and regular in artistic forms and all descriptions of types of musicianship and of music in general hinge upon clear insight into the nature of the functioning of this type of classification. Yet this is but one aspect of classification which the psychology of music contributes to the understanding and description of the musical mind in action.

It organizes the scientific description of musical tones and the means for producing them.

Psychology enables the musician to think in orderly, specific, describable, repeatable and verifiable terms. This is all new to the traditional nonscientific musician. For example, he is interested in tone quality. But what is tone quality? What is its relation to other attributes of tone? What are its determinants? What are the limits, possibilities and means for it

[1] When I was completing a series of thirty consecutive articles on the Psychology of Music in the *Music Educators Journal,* the editor, recognizing that each of these articles had been an actual contribution to music from the psychological laboratory in the attempt to show what psychology is doing for music, asked me to generalize the series by answering this question. My answer was in twelve statements, which are repeated here in italics. These statements do not mean that psychology has accomplished all these things, but rather that the way has been paved. Nor does it mean that these are the only things psychology can do, but the items listed are limited to those with which I personally have had first-hand and comparatively large experience in the psychological laboratory.

mastery? Which, if any, of the accretions of scores of fantastic names for tone quality are significant, definable and usable? These are all psychological questions with a musical meaning which may be taken into the laboratory.

One element of tone quality is timbre, but until very recently no music book revealed an adequate understanding of this concept. Definitions were often meaningless, and a waste of time and efficiency in teaching the mastery of timbre has been atrocious, largely because neither teacher nor pupil knew what it was that he was to develop and did not have any objective standards for orientation. The French pronunciation added to the mystery. Another element of tone quality is sonance. We had no name in music for this vital concept of tone quality until about fifteen years ago. Now tone quality can be explained in terms of timbre and sonance to satisfy the members of the Acoustical Society of America, the musicologists, the intelligent teachers and students of music and scientists in general. Discriminative hearing and appreciation and mastery in the control of tone quality rest upon a correct terminology and insight into the nature of the concept.

The musician can now look at the graphic picture of the tone spectrum of his violin and the graphic performance score which is recorded with a camera and shows in minute detail exactly how he performed in a given rendition. To accomplish this, psychology accepts the physicist's account of tone production as exemplified in various instruments, the physiologist's account of the vocal mechanism and the human ear, the geneticist's theory of inheritance and development, the anthropologist's account of evolution in the human race and the psychologist's account of principles of hearing. Each of these contributions thus helps the musician to know and describe a certain characteristic of voice or instrument and analyses and specifies the best means for artistic tone control and the acquisition of musical skills. To facilitate this for experimental purposes, tone generators are now available which enable us to produce any kind of tone desired according to specifications and to describe such tones quantitatively. Applied science can now improve the violin or any other instrument, build entirely new models or effect new ensembles of instruments.

It gives us an orderly insight into the nature, scope and limitations of musical hearing and appreciation.

The child says with satisfaction, "I see with my eyes and hear with my ears." That attitude, until recently, satisfied many a student and teacher of music. But there is now a very elaborate and serviceable experimental psychology of hearing, both pure and applied, for which we find countless applications in the hearing, appreciation and performance of music. The musician is now becoming interested in knowing and being able to state exactly what it is in the musical tone that he hears, appreciates, tries to perform and intends that the listener shall hear. He finds available an elaborate and technical system of laws of hearing, of which the most important are the laws of illusion in hearing. He finds that if it were not for the operation of law in illusion there could hardly be any real music. He finds that the relation between the physical sound and the sound as heard is not 1:1 and that a series of conversion tables for this relationship are of vital importance in hearing. He finds that the observation of acoustic principles determines the carrying power and the pleasantness or unpleasantness of his tone. His understanding and artistic rendition rest upon observance of these laws. The composer and the performer must be guided by definite laws of phonetics and acoustics. Musical hearing and musical criticism must take them into account. In other words, the incoming insight, interpretation, description and mastery of music hinge upon the command of principles of hearing; and the musician finds that musical education is in large part a systematic training of a discriminating ear.

It enables us to analyze and evaluate musical talents as a basis for guidance in musical education, vocational and avocational.

Musical talent is inherited in various kinds and various degrees. There is not one, but a hierarchy, of musical talents, many of which can now be analyzed clearly and measured with precision. In this equipment, nature is prolific. Education and refinement build upon selected native capacities; but most frequently a large part of this inherited endowment is lost for want of cultivation.

The magnitude of individual differences is conspicuous in music. Yet the problem in music education is to deal with each individual difference with proper recognition of the total personality in the total situation. One of the unfortunate fallacies promulgated by many music teachers is the idea that, while many children inherit a musical mind, it is their function to develop it in those children who have little or no such inheritance. But when the public school music teacher now makes a survey of musical talent in the school and finds that of two equally intelligent pupils one may have more than one hundred times as fine a sense of pitch, sense of rhythm, sense of time or sense of timbre as the other and that these are relatively independent variables so that a pupil may stand high in one and low in another, he faces a stubborn fact which he can not ignore in selecting instruments, registering pupils for training, interpreting success or failure and laying foundations for praise and blame.

It has been found that in the human races of the world to-day and in the various culture levels of civilized people, there is but little difference in the average of the elemental capacities for musical hearing; but within any such group, there is an extraordinary range of difference among individuals. There is as wide a distribution of the gift of music among the primitive South Sea Islanders as there is in the families of the social register; and in both groups the highly gifted are relatively rare and the non-gifted are in abundance. When we find that these differences in capacity are fairly independent of age, intelligence, training and culture or racial origin, we face new problems in music. Native talent is the capital which it is the business of the music educator to invest. He must therefore know what it is and how to make the best investment. Psychology has furnished the methods and means for such measurement, not only at the sensory and motor levels but also at the higher creative levels.

It furnishes the technique for the measurement of musical achievement by the analysis and objectifying of goals as a means of motivation in training.

The techniques developed for the measurement of musical talent are now carried into the field of the analysis and measurement of musical achievement. It has become possible to set up definite musical objectives as specific goals of achievement in various stages of training and to measure progressive achievement in the work toward these goals. Thus a pupil is furnished a check list of specific concepts, skills and critical judgments which are to be acquired, and may enjoy the privilege of knowing in specific terms what progress he is making from time to time. This is a powerful element in motivation and the attainment of efficiency through instruction. This organization of scientific measurement of musical achievement is going to revolutionize the musical curriculum. There will be a general housecleaning for discarding the non-essential, the undefinable and the incongruous; and the music educators are now joining in cooperative movements to determine the minimum essentials and the order of their development in terms of scientifically defined concepts.

It enables us to organize musical training in terms of a growing body of principles in educational psychology.

Educational psychology has revolutionized teaching in all other public-school subjects. Music educators and psychologists are now attempting to glean nuggets from the current literature on the various aspects of the psychology of learning in order to select and organize those general facts in educational psychology which have a bearing on the art of instruction in music. Music teachers are fast joining the ranks of those who conduct psychological experiments in the actual musical situation. It has been the function of psychology to stimulate and facilitate this movement.

It paves the way at all levels for principles of musical criticism and a logical award of praise and blame.

Historically, musical criticism has generally been impressionistic and unscholarly. But it is no longer satisfactory to fill the music columns with laudatory or condemning slush, popularly conventional, prejudiced, often subsidized. The psychology of music has begun to pave the way by furnishing the tools for logical criticism and discriminating judgment in terminology standardized for the art. Considerate and judicious criticism is one of the most promising incoming means for motivation or rightful discouragement from the child in the elementary grades to the professional on the stage. It is not only pedagogical but humanitarian to recognize individual differences in the degree and kind of musical capacity at all levels in the award of praise and blame. We can not expect equal achievement from all the children in a given grade in school; and in assigning credit for work, the modern teacher faces a new problem—the attainment of a fair balance in giving credit or discredit for achievement in relation to capacity for achievement and specific outstanding fortes and faults.

It makes possible the use of performance scores for the detailed analysis and quantifying of artistic elements in musical performance.

The greatest single contribution made in the recent advances of the psychology of music lies in the development of musical phonophotography and the invention of the graphic musical performance score, based on the objective recording of individual sound waves in the musical tone. The phonographic recording had to be supplemented by a series of phonophotographic processes. The musician can now go into the recording studio and perform with voice or instrument where, in addition to a permanent phonographic record, a series of synchronized cameras reproduce every aspect of each individual sound wave so that each note can be reconstructed in minute detail much finer than the ear can hear. This recording may be done in a dead room, which eliminates from the musical performance all those characteristics which are due to extraneous sounds and the acoustic characteristics of the music room. Thus in the time that it takes to sing a song, whether it is sung on the stage, in the radio studio or in the laboratory, we obtain a moving picture record which contains thousands of items of musical significance.

But the mastery of this type of recording revealed the necessity of a new type of language for musical performance. This has taken the form of what is known as a performance score, in which the actual

rendition of each note is graphed in such detail as may be desired in terms of clearly defined characteristics of the tone as rendered. This graphic performance score is a brand new language with a systematized series of symbols representing defined concepts for musical performance quite analogous in its significance to the language and symbols of mathematics or biology. In terms of such a performance score, any specific element in the character of the performance may be isolated for analysis and measurement. The musician will see revealed in the score an astonishing number of features of which he was not aware. The interpretation given by various artists may be compared and criticized, and new features in the phonographic record for the ear will be recognized when they have been revealed by the cameras. For the preservation of primitive music, for the criticism of great artists and for educational purposes, the resources of the performance score are inexhaustible and open up a new area of interest and proficiency in music.

Individuality in the art of musical interpretation lies largely in artistic deviation from the true, the rigid and the uniform as represented by the musical score. The performance score represents precision measurements of all forms and degrees of artistic deviation expressing artistic license, judgment and skill.

It enables us to set up norms of prevailing musical achievement and to show by experiment how these norms for attainment could and should be refined.

We do not have and do not desire fixed standards or norms in any element of musical excellence. There must be room for artistic individuality, and there are countless elements which may contribute to the goodness or badness of a voice or an instrument. But the psychology of music has introduced techniques, especially through the use of the performance score, for showing what the style, the tendencies, the limits of variability and other characteristics are in any element of the best musical performance of to-day. There is a recognizable limit of tolerance within which the artist must be restrained. For example, when we take such a debatable and often unbearable feature as the vibrato of the singer, norms can be established to show that every good singer sings with a vibrato on practically every note intoned, whether he hears it or intends it or not. It is an inalienable element of goodness in voice. On an average, the twenty-five best recognized singers of to-day have a pitch pulsation of approximately a half-tone, which seems unbelievable because it is not heard as such. They have an average rate of pulsation of about six and one-half per second, which tends to take the form of a smooth sine curve and may be in pitch, intensity or timbre and frequently is in all three. Excellent but untutored primitive singers have approximately the same kind and degree of vibrato as do recognized musicians.

But these norms of prevailing excellence in voice can readily be refined. Norms of average performance for violin and other instruments have been established. If we assume, for example, as is generally conceded, that the violin vibrato is more musically acceptable than the prevailing voice vibrato, we can take the best violin vibrato as a model for the establishment of a more ideal norm and proceed in a short time to refine the vibrato of a singer to something like the violin norm, which is barely half as conspicuous as the prevailing vocal norms. Psychologists have shown how this can be done for any pupil or any artist now on the stage. It is difficult to imagine what a tremendous advance in the art of singing such a modulation of the prevailing vibrato among singers would be if such reformation of the stage were attempted seriously. It would ban the tremolo, which is simply a bad vibrato, and would contribute vastly to the beauty in flexibility, tenderness and richness of tone. It took psychologists to show what the vibrato is, how bad the prevailing vibrato may be and how it can be improved.

It furnishes instruments and techniques which will shorten the time of musical training and yield a higher precision and mastery than is ordinarily obtained.

Thanks to the extraordinary development in the recording and transmission of sound on principles involved in the radio, we are now in a position to equip the music studio, both public and private, with training instruments. Skill in pitch intonation is gained by training in front of an instrument which shows instantly, down to a hundredth of a whole-tone step, the precision, artistic deviation or degree of error in singing or playing in pitch. The pianist can practice various principles of artistic dynamics in phrasing by keeping his eye on a dial which registers all dynamic changes in terms of defined units of intensity of tone. The student who has difficulty with rhythm can go through rigorous exercises on model patterns and see how he conforms to these patterns either in terms of time as measured in hundredths of a second or of stress as measured in terms of decibels. The most difficult feature which both vocal and instrumental students have to master is that of tone quality. And here again one can have the advantage of an instrument which shows the wave form of his tone the instant it is sounded in such a way that he can compare it with the desired norm, and can thus practice with his visual aid to extraordinary advantage. In short, music is falling in line with industry and war in turning to mechanized features as instrumental aids; and it can be said conservatively that where this is done, we can predict an extraordinary

shortening of the time of training for a specific skill and a hitherto unattainable degree of precision.

It enables us to record, preserve and interpret music in all forms of historical interest.

The musical anthropologist now faces unlimited facilities for accumulating a wealth of historical material in music. The phonograph recordings are now good, and the acoustic recordings with moving pictures now have sufficient fidelity for scientific purposes. Portable moving picture machines are now available in all parts of the world and the producers and news-gathering interests are glad to cooperate with scientists. The Hollywood producers have under consideration a plan for sending musical and linguistic anthropologists into primitive fields a year or two in advance of their proposed filming. Such an expert could thus make a preliminary scientific survey of the prevailing types of music and the performers which would be available for the filming industry and for purely scientific purposes. The industries will be repaid by the spirit of cooperation from the natives which can be cultivated. The field camera will be at the free disposal of the musical anthropologist for the recording of such scientific and artistic features as he may have found significant for the science of music. The sound tracks may be accompanied by significant moving pictures of dance and other forms of dramatic action which are essential to vitalize the music. In short, the problem of how to record primitive music is solved. The problem now before us is to find workers who can analyze and utilize that material for the history, science and art of music. The phonographic and film recording of the best music of to-day is of such high quality that any artist will be glad to be immortalized by the faithful preservation of his music through recordings. Here, again, we already have unlimited source material for scientific analysis, a gold mine for musicologists. One who was at work on the collection and preservation of music three or four decades ago is in a position to appreciate the fabulous advantages the collector of to-day has over the collector of twenty years ago.

It furnishes the groundwork for a future science and philosophy of musical esthetics.

Musical esthetics of the past has been largely a speculative armchair product. With the coming in of facilities for measurement of musical values which should constitute the groundwork of esthetics, we enter upon a radically new era in this field. Armchair theories can now be put to experiment to be verified and discarded, modified or simplified. This applies particularly to all aspects of the nature and significance of scales and every other aspect of intervals, to all studies of the evolution of musical feeling, to all aspects of the evolution of musical values, to the fundamental concepts of the power of music and to theories of goals to be attained. The study of such total problems can now be fractionated in the scientific attitude of dealing with one specific element at a time; such as some particular phase of harmony, balance, symmetry, resolution or musical license. For this purpose, a radical revision of terminology for the scientific and philosophical discussion of musical esthetics must be introduced.

The scientific procedure in a new and unlimited field of this kind is a slow and arduous process and in any generation, mere beginnings can be made. But, as in the introduction of scientific methods in the classification of plants and animals and the interpretation of their complete life histories, once the scientific attitude is made possible the purely speculative will gradually become less and less acceptable as a final solution. More progress toward a scientific approach to musical esthetics has been made in the last twenty years than in all preceding history.

Coda. There is, of course, a very large body of scientific principles and means of progress developed by musicians themselves in creative experimentation and thinking within the art. That is taken for granted. The features here discussed are drawn from contributions in current science which have a bearing on music. For the purpose of concrete illustrations, it is limited to features with which the author has had first-hand acquaintance; many other scientific approaches deserve mention. The aim has been to present a point of view and a comparatively new frame of reference for scientific thinking in music.

What is here indicated for music applies in principle to all the other fine arts, especially those of language, drama, poetry and dance. The more we rise into a consideration of the common elements of all artistic creative power and the assimilation of art in daily life and philosophical thought, the more we become aware of a common ground of interest, appreciation and cultivation of the scientific spirit in all arts, both pure and applied.

THE TASKS BEFORE US[1]

By Dr. WORTLEY F. RUDD

MEDICAL COLLEGE OF VIRGINIA, RICHMOND; PRESIDENT OF THE SOUTHERN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

MAY I say in the beginning that this is going to be no after-dinner speech, except that we have just eaten a good meal. No stories will be told, and no attempt at humor. A deadly seriousness of purpose that is

[1] Remarks of the president at the Atlanta meeting of the Southern Association of Science and Industry.

eating at my heart and at yours as, across the years, you and I have appraised the South as it is and then inventoried the region and made up from these findings a blue print of what the South can and should be, prompts me to speak briefly but very earnestly at this time.

That others are deeply concerned with these same general problems about the South at the present time is indicated by the fact that for the Memphis meeting of the American Chemical Society, to be held later this month, there has been set up a symposium on "Chemistry in the South." I have the assignment "Chemistry in Virginia" in connection with that symposium. Naturally, these two assignments in the same field have urged me to a more than casual study of these problems.

At the inauguration of Dr. Oliver C. Carmichael as chancellor of Vanderbilt University in 1938, an excellent symposium on "Graduate and Research Programs in the South" had a conspicuous place in the exercises. In a paper by Dr. Charles W. Pipkin, dean of the Graduate School of Louisiana State University, presented on that occasion, we find an excellent study of this subject so vital to our region. A single phrase from Dr. Pipkin's paper may be quoted here as setting forth a sort of ideal toward which our hopes and dreams for the South may be directed as we work together. He says, "An empire awaits a philosophy generous enough to shape a great destiny." Although taken out of its context, the phrase epitomizes so admirably both the tasks before us and the possibilities of their ultimate accomplishment that I have felt impelled to quote it here.

Were I permitted to appear before some all-powerful tribunal and given the privilege to choose the things I most desire to have, or given the ability to accomplish the things I most desire to accomplish, certainly high up in the choices I would make would come the ability to arouse the people of our region—able but smug people, thousands upon thousands of them in these southern states—to a full realization of the potentialities—the almost unlimited potentialities—that lie all around us here in this favored region.

May I also be permitted to say that were another gentleman, who is with us to-night, given the same privilege of choice, I am constrained to believe he would give this choice first place also, and, if granted his request, his enthusiasm would be so overwhelming he would forget to make any further requests of any kind. You recognize, of course, that I refer to our secretary, Dr. George D. Palmer. Seldom have I ever known such boundless enthusiasm for a cause, and such tireless energy as Dr. Palmer puts into the task of getting started among us here in the South some workable methods for studying Southern problems intelligently, and then doing something about these same problems.

Despite an all-out war effort such as none of us dreamed could ever come to this country, and which is making it impractical for many scientific societies to hold their 1942 meetings at all, our organization is celebrating its first birthday here in the very heart of the South as guests of the Georgia Academy of Science. The movement which resulted in the formation of the Southern Association for the Advancement of Science was born of a long existing and profound conviction among many leading southerners that the time was ripe for a representative cross section of the people of the region—scientists, industrialists, business men and women—to pool their knowledge and interests and talents in a common effort to do certain things for the South which must be done by some group before it, as a region, can even reasonably well take the place in the nation which, by location, climate, natural resources and native intelligence, it is richly entitled to take.

Naturally, I am aware that this sounds somewhat fantastic, or at least too idealistic. Maybe it is; time alone will determine this. However, that the movement gained sufficient momentum to bring to bear upon the problems involved at least the wishful thinking of such a representative group as we now have, is much more—I am inclined to think—than a promising gesture.

An unfortunate habit that I early developed may be illustrated as follows: In bird hunting, all too frequently, I could not resist the temptation to shoot at the covey; therefore, few bird suppers. My hunting companion always picked his bird deliberately—one or two on the rise—and usually he got them. Although I killed few birds, I did gradually learn the fallacy of this method of hunting. As I have grown older, to steer clear of "covey shooting" has become almost an obsession with me. As you know, what the Southern Association for the Advancement of Science is trying to do is to pick from the covey of problems that sorely afflict the South one or two at a time and, over the years, to study those selected with as fine persistency and efficiency, and open-mindedness, and intelligence, as there is in our region.

It would seem hardly necessary for your president to present at this time to the group already in a general way committed to the above policy, the objectives of this organization. However, as a matter of record, and also with the hope that we make every possible effort to follow this general method of attack—or some better one through the years—it may not be unwise to name a few problems any one of which probably merits all the effort we can put into it even for a decade or two.

As president of the Virginia Academy of Science a year ago, I was confronted with a similar dilemma. What could the academy do for our state? Did a group of some 800 or 900 men and women, the very cream of scientifically minded folk in Virginia including a fair number from industry and business, have any right to meet from year to year with no objective other than the reading of papers on past accomplishments and the transaction of business necessary for the well-being of the organization? Having no answer of my own, I addressed this inquiry to every academy member. Also, leading scientists throughout the country were asked the same question. The replies—and an unusually large number came in—indicated that overwhelmingly men and women believed that the academy should undertake problems of state-wide interest in which many individuals, representing all groups in the academy, might have a part. Their suggestions of practical projects opened our eyes to possibilities of such a program, if properly prosecuted. Under the guidance of what we called a long range planning committee, although less than a year has passed, one project of major interest has already been completely set up and fine progress is being made on it. The General Assembly of Virginia has just appropriated $5,000 for the publication of the first report of this work. This has been given in some detail simply to indicate how far-reaching projects may become if undertaken as a sort of composite of ideas and talents and enthusiasm and efficient leadership, intelligently directed toward specific, practical objectives.

In the light of this experience in academy work we have, during the past year, sent similar requests to a great many leaders throughout the South. Many practical suggestions about what we should do have come in as a result of this inquiry. To name just a few of these: Closer cooperation between science and industry; new and better uses for our raw materials; conservation of our forest resources; after cotton, what? The post-war South; vocational education for the South; more and better fundamental research; cooperative research; control of industry in the South by the South; decreasing the handicaps of southern industry; and literally dozens of others equally as important and applicable to our problems. The panels that are being held at this meeting illustrate well how already some of these projects are being studied.

To avoid wasting our energy in our attempts to decide upon which individual problem to place the emphasis in the beginning, may I suggest that perhaps one of the first and most important tasks of our organization is authorization of the appointment by the incoming president and secretary, acting jointly, of a committee of probably one member from each southern state whose chief duty it shall be to lay out for the years ahead a few distinctive problems which lie well within our field of endeavor. The tenure of such committee members should be reasonably long, as much time will be required for it to set up in workable form projects of major importance to the region, and then see that they are followed through. In the hands of a carefully selected group of this kind, the possibilities of our organization for effective and intelligent service for the South are limited only by the willingness of our men and women to work everlastingly at tasks that challenge the best that there is in them.

What we most need, it seems to me, is a great resurgence of social, economic, political, cultural, industrial and educational leadership in our region. Across the years, perhaps the lusty infant born at Mobile a year ago will really grow up to occupy a commanding position in bringing about fundamental changes in our way of thinking and working and living, to the end that southern science, and southern business and the southern press and southern capital and southern brains and southern raw materials and southern culture and southern research may all be so effectively meshed that our sons and daughters may stay in the South and be adequately trained for all the demands that the development of our natural resources may make upon them. That the capital required to finance a growing industry shall be southern capital; that our research—pure, industrial, economic and social—shall be done at home, and much more largely by our own southern boys and girls.

For a mere pedagogue to present such a roseate picture of what the South may become under wise and patient and persistent planning and leadership is characteristic, perhaps, of our lack of practical experience in outside affairs. Frankly, however, I would have little faith in the ability of this organization to make any considerable contribution toward the sensible working out of the things we must do, were it not that before we organized at all it was wholeheartedly agreed among us that business men, industrialists and capitalists from all over the South should have a large share in planning and directing its policies. How much in earnest such men are in these plans is evidenced by the fact that in Alabama—the birthplace of the Southern Association for the Advancement of Science—there has already been set up by the State Chamber of Commerce, as a sort of outgrowth of this organization, the Alabama Research Institute. The importance of this as a prophecy of what may and should come in other states to give these practical-minded men opportunity to have their research problems of all kinds finally worked out at home, can hardly be estimated.

It has been said, and correctly we believe, that the

number of patents awarded in any state or region is at least one measure of the progress that is being made. Such a standard of measurement applied to the South now will indicate clearly how desperately we need research—pure research, which underlies all other types; industrial research, economic research, and relatively how little of these is being done among us.

Another evidence of the business man's interest is seen in the program that has been set up for this meeting. Please note the number of influential and successful non-pedagogues that are having a share in it. Personally, my own interest in the project would be greatly curtailed if this were not the case.

It is my profound hope that more and more of both groups—business men and professional men—will look to the Southern Association for the Advancement of Science to help in their problems, and more and more will the organization be able to help in their solution.

Finally, it is my considered judgment that if we do no "covey shooting" at southern problems, but rather pick them singly and do a good job in getting our composite aim right down the barrel at them, our outlook for service to the region is genuinely heartening.

Quoting Dr. Pipkin again: "An empire awaits the philosophy generous enough to shape a great destiny."

OBITUARY

HERBERT FOX

HERBERT FOX, son of Samuel Tucker Fox and Hannah Freas Fox, was born in Atlantic City on June 3, 1880. He received his A.B. from Central High School, Philadelphia, in 1897, his M.D. from the University of Pennsylvania in 1901. He served his interneship in the Philadelphia General Hospital and in the Presbyterian Hospital, Philadelphia. In 1903–04 he was a member of the Philadelphia Typhoid Commission; in 1904, pathologist to the Rush Hospital, Philadelphia; in 1905–06, second assistant in pathology under Heinrich Albrecht in Vienna.

In 1906 he became pathologist in comparative pathology for the Philadelphia Zoological Society, a position he held until his death. He at once took a leading part in the scientific studies emanating from the collection in their Zoological Gardens. He studied particularly the incidence and control of tuberculosis among the primates and in his last decade the pathology of arteriosclerosis in mammals and birds and of chronic arthritis. His large monograph on "Disease in Captive Wild Mammals and Birds" (1923) is based on the record of 6,000 autopsies performed under his supervision. It is a thorough and exhaustive treatise widely used as a reference work. Under his direction the Zoological Society's Penrose Research Laboratory, the pioneer institution of its kind, rose to its position of leadership. He became professor of comparative pathology, University of Pennsylvania, in 1927.

From 1906 to 1911 he was officer in charge of the laboratory of the Pennsylvania Department of Health.

In 1911 he succeeded Alfred Stengel as director of the William Pepper Laboratory of Clinical Medicine, University of Pennsylvania, which position also he held until his death. Here he guided the development of the laboratory facilities in the university's major teaching hospital through the period of rapid advance of the clinical laboratory. His own contributions were especially in relation to diseases of the lymphatic tissues.

He was co-author with Alfred Stengel of four editions of their "Textbook of Pathology."

In 1915 he was a member of the commission managing the outbreak of poliomyelitis at Erie, Pa. From 1915 to 1926 he was pathologist to the Children's Hospital, Philadelphia. In the World War he served from 1917 to 1919 as major, in charge of the cantonment laboratory at Camp Zachary Taylor, Louisville, Ky.

He was a fellow of the College of Physicians of Philadelphia and of the American Association for the Advancement of Science and a member of the American Philosophical Society, the Association of Pathologists and Bacteriologists, the American Society of Clinical Pathologists, the American Medical Association and the Academy of Natural Sciences of Philadelphia, as well as of several honorary fraternities.

He died on February 27, 1942, after several months of illness.

In 1904 he married Louise Carr Gaskell, who died in 1933. Of their three children, two survive, Margaret Fox Hentz and Samuel Tucker Fox, 3rd. In 1938 he married Mary Harlan Rhoads, who survives him.

In his work he was meticulous to secure perfection in the smallest details. An omnivorous reader, he was a connoisseur of many of the arts and a welcome companion at any gathering. His happiest hours were probably those in which he lightly dropped an almost invisible fly on the ripples of the streams in Pennsylvania or Nova Scotia.

J. HAROLD AUSTIN

RECENT DEATHS AND MEMORIALS

THE death at the age of sixty years is announced of Charles Francis Harding, professor of electrical engineering and director of the electrical laboratory at Purdue University.

DR. CARL OSCAR JOHNS, chemical consultant, director of research, retired, of the Standard Oil Development Company, died on April 18, at the age of seventy-one years.

DR. SHIRLEY W. WYNNE, from 1928 to 1933 health commissioner of New York City, died on April 19, at the age of fifty-nine years.

DR. JOHN BALDWIN WALKER, until his retirement in 1938 professor of clinical surgery at the College of Physicians and Surgeons, Columbia University, died on April 13, at the age of eighty-two years.

DR. MARIA M. ROBERTS died on April 12, at the age of seventy-four years. Among the offices held during her fifty years of service at the Iowa State College were the positions of dean of the Junior College and professor and head of the department of mathematics.

PROFESSOR JEAN PERRIN, Nobel laureate in 1926, formerly president of the French Academy of Sciences, died on April 17 at the age of seventy-one years. Since Dr. Perrin came to the United States last December he has been dean of the faculty of sciences of the recently established Franco-Belgian Free School of Higher Studies.

IT is planned to establish a library in the University Hospital, in Philadelphia, in honor of the late Dr. George E. de Schweinitz, professor emeritus of ophthalmology of the University of Pennsylvania School of Medicine. Friends of Dr. de Schweinitz have undertaken to finance the project.

SCIENTIFIC EVENTS

THE WILLIAM LOWELL PUTNAM MATHEMATICAL COMPETITION

PROFESSOR W. D. CAIRNS, secretary-treasurer of the Mathematical Association of America, reports that the department of mathematics of the University of Toronto, Canada, won the first prize of $400 in the fifth annual William Lowell Putnam Mathematical Competition held on March 7. This is the third year in five that the University of Toronto has taken first place in the competition made possible by the trustees of the William Lowell Putnam Intercollegiate Memorial Fund, left by Mrs. Putnam in memory of her husband, a member of the Harvard class of 1882, and sponsored by the Mathematical Association of America. The members of the Toronto team were K. S. Hoyle, H. V. Lyons, M. A. Preston.

The second prize of $300 is awarded to the department of mathematics of Yale University, the members of whose team were F. H. Brownell, 3rd, A. M. Gleason, A. E. Roberts, Jr.

The third prize of $200 is awarded to the department of mathematics of the Massachusetts Institute of Technology, with a team composed of E. D. Calabi, W. S. Loud, G. P. Wachtell.

The fourth prize of $100 is awarded to the department of mathematics of the College of the City of New York, the members of whose team were Herman Chernoff, Harvey Cohn, Edward Gordon.

In addition to these prizes to the departments of mathematics with winning teams, a prize of $50 each is awarded to the following five persons given in alphabetical order whose scores ranked highest in the six-hour examination: Harvey Cohn, College of the City of New York; A. M. Gleason, Yale University; W. S. Loud, Massachusetts Institute of Technology; H. V. Lyons, University of Toronto; M. A. Preston, University of Toronto. One of these five will later be chosen to receive a $1,000 a year scholarship at Harvard University.

The members of the four winning teams will receive individual cash awards according to the ranks of their teams, and all individuals receiving awards will also receive medals.

Honorable mention has been awarded this year to four teams and to five individuals. The teams are from the department of mathematics, Cooper Union Institute of Technology, New York, members of the team being Harold Grad, M. S. Klamkin, Kenneth Robinson; the department of mathematics, Harvard University, Cambridge, members of the team being R. M. Bloch, L. S. Shapley, J. A. Zilber; the department of mathematics, New York University, New York, members of the team being Melvin Lax, Harold Lewis, Henry Shenker; and the department of mathematics, Swarthmore College, Swarthmore, members of the team being N. B. Hannay, W. H. Mills, M. S. Raff. The five individuals receiving honorable mention are E. D. Calabi, Massachusetts Institute of Technology; C. P. Gadsden, Tulane University; K. S. Hoyle, University of Toronto; Melvin Lax, New York University; W. H. Mills, Swarthmore College.

THE INTER-AMERICAN TREATY ON NATURE PROTECTION

THE National Parks Association reports that seven countries have ratified the Inter-American Treaty on Nature Protection and Wildlife Preservation to date, three of them since the United States entered World War II on December 8, 1941. This is welcome evidence of the intention to continue permanent cooperation among the nations of the Western Hemisphere for the peaceful purposes of preserving unique natural features, historic objects and vanishing wildlife.

Haiti became the fifth country to deposit its ratifi-

n with the Pan American Union on January 31, 2. In accordance with the provision of the original vention between the American republics, that it ll come into force three months after deposit of less than five ratifications with the Pan American on," the treaty will take effect in the ratifying tries on May 1 of this year.

n order of deposit, the seven ratifying countries as follows: the United States of America, April 7, 1; Guatemala, August 14, 1941; Venezuela, Novem- 3, 1941; El Salvador, December 2, 1941; Haiti, uary 31, 1942; the Dominican Republic, March 3, 2, and Peru (not yet deposited).

he original convention has been signed by the rep- ntatives of eleven other Latin-American countries, ing only three that have taken no action to date. cies of fauna and flora to be specially protected er the treaty have already been designated by addi- to the convention for Argentina, Bolivia, Brazil, Dominican Republic, Ecuador, El Salvador, Guate- , Mexico, Nicaragua and the United States.

he first official step towards realization of a Pan- erican program for nature protection was taken the signing of the original convention in Wash- ton, D. C., on October 12, 1940. Now that the sec- step is assured with the coming into force of the ty on May 1, it remains for each ratifying country fulfil its obligations by enacting enabling legislation issuing executive orders or decrees to implement treaty and effectuate its purposes. Continual ef- s to foster public education in the field of con- vation will be necessary to give these official policies ctical application and significance throughout the w World.

he objects of the treaty are to protect and preserve ive fauna and flora in the American republics, in- ding migratory birds, and to protect and preserve nery of extraordinary beauty, unusual and striking logic formations, regions and natural objects of hetic, historic or scientific value. It provides for establishment of national parks, national reserves, ture monuments and strict wilderness reserves as n as possible after its effective date.

RANTS OF THE NUTRITION FOUNDATION

HE Nutrition Foundation, Inc., recently organized h the support of the food industry, will make its t series of grants, to promote research and educa- n in the science of nutrition, effective on July 1. announcement made by George A. Sloan, presi- t of the foundation, reads in part:

> Grants made by the foundation will go to established itutions in the United States and Canada. The first es of grants, effective July 1, will be made following ion to be taken by the trustees at their May meeting. Problems of critical importance in the war emergency will be given primary consideration. Food supplies for our allies and for specialized divisions of our armed forces as they spread to the far corners of the earth can not be provided without careful planning and adequate precautions.
>
> Grants will also be made in the support of projects that have a direct bearing upon public health. There is obvious need for more information concerning the relation of diets to dental caries, and much remains to be discovered regarding the nutritional requirements of infants, growing children and people in old age. The foundation's long-time program, however, will place greatest emphasis upon fundamental research to advance the frontiers of science.

A CHINESE SCIENTIFIC SOCIETY ON WEST COAST

THROUGH the efforts of a number of Chinese scientists and technical students in Southern California a new scientific society has been organized, to be called the "Chinese Natural Science Association, U. S. West Coast Chapter," under the auspices of the Chinese Natural Science Association at Chungking, China. The aim of this new organization is the advancement of study and research in the natural sciences and the attainment of a closer cooperation among the scientific workers of China and the United States.

The chapter now has two sections: one in Northern California centered at Berkeley and one in Southern California.

The first meeting was held on March 8. Professor Carl D. Anderson, of the California Institute of Technology, spoke on "Cosmic Rays and the Elementary Particles of Matter," and Dr. Hsueh Chung Kao spoke on "Vitamins in Nutrition." The second meeting will be held on April 12. Dr. John A. Anderson will speak on "The 200-inch Telescope" and Dr. Tze-Tuan Chen, lecturer in zoology, University of California at Los Angeles, will speak on "Some Recent Advances in Protozoology."

THE AMERICAN SOCIETY OF MAMMALOGISTS

THE twenty-fourth annual meeting of the American Society of Mammalogists was held at the American Museum of Natural History, New York City, from March 31 to April 4.

Officers of the society elected for the ensuing year are as follows: *President,* A. Brazier Howell, department of anatomy, the Johns Hopkins Medical School; *Vice-presidents,* E. Raymond Hall, University of California at Berkeley, and Edward A. Goldman, U. S. Fish and Wildlife Service, Washington, D. C.; *Recording Secretary,* Seth B. Benson, University of California at Berkeley; *Corresponding Secretary,* Emmet T. Hooper, University of Michigan, Ann Arbor; *Treasurer,* Viola S. Schantz, U. S. Fish and Wildlife Service, Washington, D. C.; *Editor,* William B. Davis,

Texas Agricultural and Mechanical College, College Station. *Directors,* elected for the period 1942–44, are: William H. Burt, University of Michigan; J. Kenneth Doutt, Carnegie Museum, Pittsburgh; Claude W. Hibbard, University of Kansas; Olaus J. Murie, U. S. Fish and Wildlife Service, Jackson, Wyo.; and W. E. Saunders, London, Ontario. *Additional directors* are Victor H. Cahalane, National Park Service; William J. Hamilton, Jr., Cornell University; J. Eric Hill, American Museum of Natural History; Remington Kellogg, U. S. National Museum, and Otis Wade, State University of Nebraska.

Since in times of stress, such as the present, there is danger that public resources of permanent value may be exploited unduly to furnish food and other materials, the society passed a resolution opposing the use of any such materials from National Parks, National Monuments or National and State Wildlife Refuges, unless it be demonstrated that such materials can not be obtained elsewhere. It was also resolved that as investigations are now in progress to determine whether or not it will be necessary to exterminate the deer of the Seminole Indians Reservation in order to eradicate tick fever in cattle, to oppose destruction of the deer until the investigations are completed and the results are made public for consideration by the authorities concerned and with due regard to the rights of the Indians.

THE AMERICAN ASSOCIATION OF PATHOLOGISTS AND BACTERIOLOGISTS

AT the annual meeting of the American Associati of Pathologists and Bacteriologists, which opened St. Louis on April 2, the following officers w elected for the coming year: Dr. Paul R. Can *President;* Dr. Wiley D. Forbus, *Vice-president;* Howard T. Karsner, *Secretary;* Dr. Alan R. Mor *Treasurer;* Dr. Shields Warren, *Incoming Mem of Council;* Dr. Francis Bayless, *Assistant Secreta* and Dr. Granville A. Bennett, *Assistant Treasurer.*

Dr. Esmond R. Long, director of the Henry Phip Institute of the University of Pennsylvania, w elected the representative of the association in Division of Medical Sciences of the National Resear Council, and Dr. Jacob Furth, of the department pathology of the Cornell University Medical Colle was appointed a member of the Advisory Commit of the Lymphatic Tumor Registry of the associati

The Gold Headed Cane of the association w awarded to Dr. James Ewing, professor of oncolo at the Cornell University Medical School, forme director of Memorial Hospital.

The next annual meeting of the association will held in Chicago on April 1 and 2, 1943. At this me ing a symposium is planned on Infectious Gra lomas, exclusive of tuberculosis and syphilis. Wiley D. Forbus has been elected referee.

SCIENTIFIC NOTES AND NEWS

THE National Academy of Sciences will begin its annual meeting at Washington, D. C., under the presidency of Dr. Frank B. Jewett, at the usual time on the 27th of the month, the fourth Monday in April. The meeting this year, however, will be limited to two days, and there will be no presentation of scientific papers or social functions, except a smoker for members on Monday evening. Apart from the annual election of members the time will be devoted to a discussion of the present work of the academy, with special reference to the provisions of its charter which makes it the scientific adviser of the government. The National Research Council, a committee of the academy, which was organized in the emergency of the last war by President Wilson, is now active in the study of scientific problems connected with war work.

THE American Philosophical Society, under the presidency of Roland S. Morris, is meeting on Thursday, Friday and Saturday of the present week in the hall of the society, on Independence Square, Philadelphia. The sessions on Thursday were devoted to an archeological program, the Franklin Medal Lecture being given in the evening by Dr. Sylvanus G. Morley, of the Carnegie Institution of Washington. The Pr rose Memorial Lecture is given on Friday evening Dr. James R. Angell.

DR. MARSTON T. BOGERT, emeritus professor organic chemistry at Columbia University, has be elected to honorary membership in the Society Chemical Industry of England, an organization which he is the senior past-president. Upon the co pletion of his presidential term in 1913, he was su ceeded by Sir William Crookes.

Nature reports that S. Bairstow, of the Chemic Research Station, Research Department of the Lo don Midland and Scottish Railway, has been award the Herbert Jackson Prize for 1941, for a paper titled "The Relation between Calorific Value and t Road Performance of Producer-Gas Vehicles."

THE William Julius Mickle Fellowship of the Un versity of London has been awarded to Profes Alexander Fleming, professor of bacteriology in S Mary's Hospital Medical School.

THE Academy of Medicine of Washington, D. C held a dinner meeting on April 22 to hear an addre entitled "War's Contribution to Medicine, and Me

's to War" by Professor Henry E. Sigerist, di-
tor of the Institute of the History of Medicine
the Johns Hopkins University. Officers of the
demy recently elected are: *President,* Joseph F.
r; *Vice-president,* Ralph E. Gibson; *Treasurer,*
er M. Choisser; *Secretary,* (re-elected), Errett C.
ritton; *Board of Directors,* Matthew Perry, Roscoe
Spencer, Lyman J. Briggs, Prentiss Willson and
rles Thom.

AT the Nashville meeting of the Southern Society
Philosophy and Psychology the following officers
e elected: *President,* Dr. Christian Paul Heinlein,
rida State College for Women; *Secretary-Trea-*
rer, Dr. Wayne Dennis, Louisiana State University;
mbers of the Council, Dr. Elizabeth Duffy,
man's College of the University of North Caro-
, Dr. S. Rains Wallace, Tulane University, and
Peter A. Carmichael, Louisiana State University.
e meeting next year will be held in Chattanooga.

DR. LAURENCE H. SNYDER, professor of zoology at
Ohio State University, will become chairman of
department of zoology and entomology on July 1,
ceeding Dr. Raymond C. Osburn, who is retiring
h the title emeritus. He has been chairman since
17. During eighteen years of this period, 1918 to
36, Dr. Osburn was director of the Franz Theodore
ne Laboratory on Gibraltar Island in Lake Erie.

Chemical and Engineering News states that William
Fulton, senior surgeon in the U. S. Public Health
rvice Reserve, a former director of the Bureau of
dustrial Hygiene of the Pennsylvania Department
Health, has been appointed chief of the Health
vision, U. S. Bureau of Mines. He will direct the
feguarding of the physical welfare of workers in
e mineral industries.

DR. THOMAS B. MCKNEELY, passed assistant sur-
on in the U. S. Public Health Service, has been
signed to the Medical Division, Office of Civilian
fense, to assist in the organization of emergency
dical services throughout the United States.

ACCORDING to the *Journal* of the American Medical
sociation, Dr. Julius Hass, who formerly occupied
e chair of orthopedic surgery at the University of
ienna, has been appointed attending orthopedic sur-
on, in charge of the Orthopedic Service, at Monte-
re Hospital, New York City.

DR. RUTH HARTLEY WEAVER, registrar of vital
tistics of Philadelphia, has been appointed director
health to succeed the late Dr. Martha Tracy. Dr.
eaver has served as epidemiologist of the city de-
rtment of health and is at present assistant profes-
r of epidemiology and vital statistics in the Temple
niversity School of Medicine.

DR. ELSA ORENT-KEILES, formerly of the department of biochemistry of the School of Hygiene and Public Health of the Johns Hopkins University, is now in charge of the Nutrition Research Laboratories and assistant chief of the Foods and Nutrition Division of the Bureau of Home Economics, U. S. Department of Agriculture, Beltsville Research Center, Maryland.

DR. RALPH G. MEADER, assistant professor of anatomy at the Yale University School of Medicine, has been appointed assistant to the director of the Jane Coffin Childs Memorial Fund for Medical Research. He will act as supervisor during the absence of Lieutenant Colonel Stanhope Bayne-Jones, director, who has reported for duty in the Office of the Surgeon General, Washington, D. C.

DR. CARL J. KLEMME, professor of pharmaceutical chemistry at the University of Minnesota, has become administrator of the experimental research laboratories of Burroughs, Wellcome and Co., Inc., Tuckahoe, N. Y.

THE Hercules Powder Company has established a fellowship for the year 1942, to be known as the Pine Chemicals Fellowship, at Mellon Institute of Industrial Research, University of Pittsburgh. Dr. George B. Feild of the institute will be the fellow.

DR. OLIN SEWALL PETTINGILL, JR., of the department of zoology of Carleton College, has been appointed editor of the Aves section of *Biological Abstracts.* He will handle the non-economic papers. Dr. W. L. McAtee will remain as associate editor to continue his work on the economic aspects of birds. Dr. Peter Gray, of the University of Pittsburgh, has been appointed editor of a new section, Apparatus and Technique, which will appear in an early issue. Dr. C. E. Blye, Division of Veterinary Medicine, University Farm, University of Minnesota, has become editor of the section of veterinary bacteriology and pathology; he takes the place of Dr. A. F. Sellers, who has been called to military service.

ON the evening of April 10, Professor Marston T. Bogert, of Columbia University, addressed the New York Section of the American Chemical Society and their friends at the Hotel Pennsylvania on the subject, "The Ramparts the Chemist is Guarding," in the course of which he discussed malaria and the serious quinine situation now confronting the world as the result of the occupation of Java by the Japanese.

AT a joint meeting on April 16 of the Washington Academy of Sciences and the Philosophical Society of Washington, Dr. Paul R. Heyl, chief of the Section on Sound of the National Bureau of Standards, delivered an address entitled "Cosmic Emotion."

THE American Astronomical Society will meet at the Yale University Observatory on June 12, 13 and 14.

UNDER the joint sponsorship of the department of physics of the University of Pennsylvania and of the Philadelphia District Committee of the American Society for Testing Materials, there will be held on Friday and Saturday, May 15 and 16, at the University of Pennsylvania, a symposium on the physics of pigments and glasses. Leading technical authorities will prepare papers, and invitations are being extended to physicists, engineers and scientific men concerned with the problems to be covered. Dr. Frederick Seitz, of the university, is chairman of the joint committee in charge of the meeting.

A JOINT meeting of the American Association for the Advancement of Science, Section C, and the American Society for X-Ray and Electron Diffraction will be held at Gibson Island, Md., from July 27 to 31. Registration and reservations are made through the director of the Gibson Island Conferences, Professor Neil E. Gordon, Central College, Fayette, Mo. A business meeting of the American Society for X-Ray and Electron Diffraction will be held at the Conference Room, on the afternoon of July 29.

Nature writes: "In 1939 the Australian Anthropological Association was formed after discussion between the Anthropological Associations of New South Wales, Victoria and South Australia at the meeting of the Australian and New Zealand Association for the Advancement of Science held in Canberra that year. The headquarters of the new association are to be situated in rotation for a period of two years in each State of the Commonwealth in which there is an anthropological society affiliated with the association. During the first two years of its existence the headquarters of the association were in Adelaide. Now they are at Sydney and will remain there until October 1, 1943, when they will be transferred to Melbourne. The official organ of the association is *Mankind,* which is the official journal of the Anthropological Society of South Australia. Officers of the association are as follows: *President,* Professor A. P. Elkin; *Vice-president,* F. L. S. Bell; *Hon. Secretary-Treasurer,* G. W. Watkins ("Hansard" Staff, Parliamentary House, Sydney)."

THE name of the Laboratory of Vertebrate Genetics of the University of Michigan has been changed by act of the Board of Regents to the Laboratory of Vertebrate Biology. The change in name was made in order to indicate more adequately the scope of the laboratory, which for a number of years has included studies in ecology and in speciation as well as in genetics.

A HANDBOOK of physical constants, edited by F cis Birch, containing 325 pages, has been publi by the Geological Society of America. It con twenty-one sections prepared by nineteen speci cooperating through the divisions of chemistry, p ics and geology of the National Research Co Copies may be consulted in geological libraries can be purchased from the Geological Society America, 419 West 117th Street, New York. N.

THE department of public health at the M chusetts Institute of Technology is offering an a erated program of public health training begin on June 8 and allowing for the completion master's degree by February 6. These training grams are organized for public health engin health educators and workers in public health la tories, as well as for administrators. Special sum courses are also being offered.

AT Yale University faculty members are coop ing in the field of physical chemistry on a pro of significance to the war effort. The investig is being made at the university under the aus of the U. S. Office of Scientific Research and D opment. It is under the direction of Dr. Herber Harned, professor of chemistry, assisted by: R G. VanName, research associate; Benton B. O associate professor; John E. Vance, associate pro sor; George M. Murphy, assistant professor; H C. Thomas, assistant professor; Julian M. Sturte assistant professor; Scott E. Wood, instructor; H old G. Cassidy, instructor; and James English, instructor.

THE engineering education of women for servi Connecticut war industries will be undertaken spring by the Engineering, Science and Manage Defense Training Program of Yale University. courses will be given in cooperation with the N Haven Y. M. C. A. Junior College and the Bri port Engineering Institute. During the next e months Connecticut must train and employ 60 women in war industries, according to Profe Hughes, the representative of Yale University. immediate need is said to be for 11,000 women. this number, a portion will receive training on engineering level.

APPROPRIATIONS amounting to nearly two mil dollars for research to further the war effort h been made by the Government of the United St to the University of California. According to a st ment made by Dr. Robert G. Sproul, president of university, the larger part of the money will be pended on two projects—the cyclotron, under direction of Professor E. O. Lawrence, at Berke and the sound laboratory at San Diego, under

direction of Professor Vern O. Knudsen, dean of the graduate division at Los Angeles. It is stated that research projects from other places are being carried out at the University of California. The work, however, is of a confidential nature and information regarding it is forbidden.

DISCUSSION

CARBONATE-APATITE AND HYDROXYL-APATITE IN URINARY CALCULI

CALCIUM phosphate often has been reported as a constituent of urinary calculi, but the specific phase or phases present have long remained unidentified. Recently, however, Jensen[1] has found that a substance designated by him as colloidal apatite occurs in many phosphatic calculi. We have examined a small collection of kidney and bladder calculi by x-ray diffraction and optical methods and have found 31 individual stones to be composed in part or entirety of carbonate-apatite (dahllite). Hydroxyl-apatite was identified in one stone, and its presence in small amounts was suspected in two other stones. No other calcium phosphates were found, but Jensen has reported brushite ($CaHPO_4 \cdot 2H_2O$) and whitlockite ($Ca_3(PO_4)_2$) in single instances. Carbonate-apatite, together with calcite, aragonite and vaterite B (μ-$CaCO_3$), has also been recognized by Phemister, Aronsohn and Pepensky[2] among the inorganic constituents of cholesterol gallstones.

Stones composed wholly of carbonate-apatite are relatively rare. Whewellite ($Ca_2O_4 \cdot H_2O$), weddellite ($CaC_2O_4 \cdot 2H_2O$) and especially struvite ($NH_4MgPO_4 \cdot 6H_2O$) are ordinarily present in greater or less proportion. Carbonate-apatite was not found in the five uric acid stones available for examination. Sufficient data are not yet at hand to warrant any conclusions as to the clinical significance of carbonate- and hydroxyl-apatite in urinary deposits.

The substances appear under the petrographic microscope as irregular grains with a banded or spherulitic structure. The material usually is colorless, pale yellow or brown. In some instances the color is deep reddish brown or an intense greenish yellow. The substances are sensibly isotropic, and the index of refraction varies widely both in different stones and in the same stone. The observed extremes in index are 1.520 and 1.605, but the usual range is 1.555–1.590 and the average value of all our measurements is about 1.575. The range in index between different layers in a single calculus is, on the whole, about 0.025, but may extend to as much as 0.04. The isotropic character is due to aggregate polarization in a mass composed of submicroscopic crystallites. The variation in index doubtless is due to variation in the content of adsorbed and capillary water. The material is not amorphous, as has been stated, and affords a distinct, although rather diffuse, x-ray powder pattern of the apatite type. It is interesting to note that the isotropic carbonate-fluor-apatite which forms the major constituent of fossil bone and teeth has in general a much higher range of indices. Rogers[3] found half of 250 measurements to lie between 1.600 and 1.610, with an overall range of 1.573 to 1.621. This difference must be due to the relatively large water content of the urinary deposits, since the macrocrystalline fluorine-containing apatites have in general lower indices than apatite members containing only hydroxyl.

A bladder stone composed of carbonate-apatite admixed with about 0.2 per cent. struvite was examined in some detail. The stone weighed 65 grams. A quantitative chemical analysis gave CO_2 5.50, Cl none, F none, H_2O lost at 110° 4.86, H_2O lost at 1000° 4.97 (total H_2O 9.83). The index of refraction largely ranged between 1.575 and 1.590. About three fourths of the total water content was lost by heating at 305° and the index increased to values in the range 1.595–1.605. The rest of the water was expelled by heating at 1000° C and the index increased to values between 1.635 and 1.655 with most grains about 1.643; this material was quite isotropic but gave a very sharply defined apatite-like x-ray pattern.

Hydroxyl-apatite can be distinguished from carbonate-apatite by the lack of effervescence in weak HCl. The test is conveniently made on crushed grains on a glass slide under moderate magnification. The indices of refraction are not diagnostic, as the slight differences in indices existing in macrocrystalline, birefringent samples are obscured by the large and variable content of non-essential water in the substances as they appear in isotropic urinary deposits. It should be emphasized that an isomorphous series in point of carbon content exists between the two compounds. The general formula may be written $Ca_6(OH)_2(P,C)_6O_{24}(Ca,C)_4$.

CLIFFORD FRONDEL
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THE SACRAL SPOT IN BENGAL

IN the summer of 1941, while engaged upon a serological study of a pair of fraternal Sindi twins in Calcutta, a faint discoloration was noticed on the

[1] A. T. Jensen, *Acta Chirurgica Scandinavica*, 84: 207, 1940.

[2] D. B. Phemister, H. G. Aronsohn and R. Pepensky, *Annals of Surgery*, 109: 161, 1939.

[3] A. F. Rogers, *Bull. Geol. Soc. Amer.*, 35: 535, 1924.

sacral area of both the male and the female at the age of three months. This was suspected of being a so-called "Mongoloid spot," already fading out.

There were only a few days available before I had to leave and I was able to examine fifty new-born Bengali babies at the Lady Dufferin Victoria Hospital in Calcutta, as well as eight infants from other provinces. In this small sample of bluish-grey irregular pigmented patch on the sacro-coccygeal and gluteal regions was observed in 38 and absent in 12 of the 50 Bengalis. The pigmented spot varied from a small patch 1 to 3 inches in diameter over the sacrum, or to one side, to a large irregular discoloration over the whole area, or one patch over the sacrum and another over one or both buttocks. These children belonged chiefly to Bengali Brahmin, Kayastha and Muslim communities; a few were classified by caste as shown in Table I.

TABLE I

SACRAL SPOT IN 16 BENGALI BABIES BY CASTE

Caste	No.	Spot present	Spot absent
Bania	2	2	0
Brahmin*	4	4	0
Goldsmith	1	1	0
Kayastha*	4	2	2
Tatti (weaver)	2	0	2
Vaidya*	1	1	0
Muslim	2	2	0

* High-caste Hindus.

The spot was familiar to the Indian nurses, and it is called "jot" (spot) in Bengali. One nurse from the Himalayan region said, "We call it the sign of a Hill baby," the Hill people being, of course, the Mongoloid Nepalese and Tibetans.

In answer to my inquiry Mr. S. S. Sarkar, of the Bose Institute, wrote, "Mongolian spots are quite common in Bengali children. They can be observed up to a certain time after birth when the skin is a bit lighter, but with age the skin gets darker and the spots can not be distinguished. Instances of its persistence up to a fairly adult age are, however, known. . . . I have seen it in German babies in Berlin."

On the way home I was able to visit the maternity ward of the General Hospital of Batavia, Java. The doctor in charge kindly allowed me to examine all the newborn babies. He said that the Mongoloid spot was such a universal feature of the natives that it is taken for granted. He also reported that it is absent in the Dutch infants and also in the Indonesian × Dutch hybrids. There were well-marked spots, similar to those observed in Calcutta, in 15 Javanese babies examined and no spot on the one Dutch and one Eurasian baby present. The Javanese belong to the Malayan branch of the Mongoloid race.

Even though the sacral spot may be a recessive character, it evidently segregates out in later generations from racial crossings; Mr. Sarkar saw it in Prussian babies and it has been reported in Hungarians and Roumanians[1]; all these European stocks contain a Mongoloid Slavic strain. In India, it is my impression that the sacral spot is rare among Anglo-Indians (as the Eurasians are called). It was absent in six Anglo-Indian babies examined last summer in Calcutta. Its occurrence in Hawaiians, Portuguese and Whites in Hawaii has been recorded by Larsen and Godfrey,[2] who also found that it segregated out in the descendants of crossings between these races in ratios that fitted a two-factor theory of inheritance for the spot, involving a dominant gene for pigment and a recessive determiner. They concluded that it is probably a universal human character, not a racial one, and that it is vestigial or rudimentary in Western Europeans.

The sacral spot has been reported in 3.78 per cent. among 11,784 babies in Turkey, mostly Turks.[3] In India, besides the Sindi twins, the spot was observed in a native of Goa from western India; in a Punjabi Sikh baby and a Muslim from the United Provinces. A Christian missionary nurse told me, in 1941, that she had seen the spot on babies of converts from various Hindu lower-castes at Gorapur, United Provinces. In a Madrasi Tamil baby examined it was absent.

It therefore seems that the sacral spot is fairly wide-spread in northern and eastern India. There is a Mongoloid aboriginal strain in Bengal and Behar, and observations on this character in Mundas, Santals and other tribes would be of interest. There were no doubt Mongoloids in the forces of the Afghans and Moghuls who long ruled northern India and Bengal.

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CREDIDMUS JOVEM REGNARE

PROFESSOR RITTER'S recent article on Darwin[1] brings up a question on which there has been much discussion, some of it in the nature of a lament for a view of nature which has passed. Aside from the matter of the scientific method involved, there is the point which seldom receives much consideration from biologists, and that is Darwin's recognition that, as one consequence of his hypothesis, the field of ethics must receive some attention. But if the vision of the author of Ecclesiastes was truly prophetic, we should

[1] E. Baur, E. Fischer and F. Lenz, "Human Heredity." London, 1931.

[2] N. P. Larsen and L. S. Godfrey, *Am. Jour. Phys. Anthrop.*, 10: 253–274. 1927.

[3] Henry Field, *Am. Jour. Phys. Anthrop.*, 27: 119–126. 1940.

[1] SCIENCE, 95: 58, 1942.

find some other similar episode in human history. One such is to be found among the ancient Greeks, and, as in the present episode, science was held blameworthy. Perhaps the antiquity of the episode is sufficient to enable us to view it impersonally and objectively in the present.

Burnet[2] remarks: "My aim has been to show that a new thing came into the world with the early Ionian teachers—the thing we call science—and that they first pointed the way which Europe has followed ever since, so that, as I have said elsewhere, it is an adequate description of science to say that it is 'thinking about the world in the Greek way.'"

A student, in talking with me recently, remarked that he had never seen any real definition of the scientific method, although he had heard much about it. My reply was that perhaps an idea of the scientific method was to be gained only by a study of the way in which men of science had gone about the solution of their problems. And a knowledge of how the Greeks thought about the world is to be gained only by a study of their work. But let us grant Burnet's contention, as I am more than willing to do without reservation. And passing over the controversy between him and Stace (p. vi) as to whether Parmenides was "the father of Materialism" let us look briefly at some of the consequences of "thinking about the world in the Greek way."

One great change which occurred in the period from Thales to Plato was the substitution of a world, perhaps even a universe, of law for the older world of caprice. The older, traditional view of the world broke down, and with the passing of the traditional view of nature, "the ancestral maxims of conduct" were more seriously questioned. Aristotle faced the problem of developing a system of ethics, as one result of the work of the earlier Greeks. Whether the results of Aristotle's attempts are to be regarded as wholly satisfactory or not is a question which I shall not attempt to answer. But there is evidence, drawn from his Greek and Roman successors, that his attempt was not wholly satisfactory to them.

It has been said that the aim of the Stoics was to develop a "philosophy for the practical man." Cleanthes, leading political philosopher of his day in Athens, and probably the most influential of all in the selection of candidates for university professorships, tried to stabilize the view of the world which had been attained by his time, and accused Aristarchus of Samos of impiety for suggesting a new view of the nature of the sun. There is little doubt that the Roman poet Horace, from whose ode I have taken my text, lived in an even worse time than that of Cleanthes. For some reason, the philosophy for the practical man had not worked out as the Stoics thought it might, and the older view of nature had never been fully restored. But would the substitution of Jove and his thunderbolts for the view of nature current in the time of Horace really have improved conditions very much? Or was there some other phase of the problem, some other unknown quantity in the equation? And were the men of science of previous centuries the ones most blameworthy for the development of the conditions which Horace lamented?

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[2] "Early Greek Philosophy," 4th ed., 1930, p. v.

A SIMPLE METHOD OF CONTROLLING TERMITES

ACCORDING to various reports termites cause damage to frame buildings in this country that amounts to millions of dollars annually. This damage could be reduced considerably if precautions were taken to prevent the termites from entering a building while it is being constructed. The author has found a very simple and inexpensive method of keeping them out of his own home, and it should be applicable to almost any building regardless of the kind of material used in its construction. At every place where the building touches the ground discarded lubricating oil drained from the crankcase of an automobile was poured into little ditches around the supporting foundation. The house used for the experiment has 56 concrete piers in the foundation. Around each of these about a quart of discarded oil was poured. A proportionate amount was poured around the base of the chimney. One place around some concrete steps was inadvertently overlooked. At this place termites entered the house, but at no other place. These were killed with fumes of chloroform, and oil was applied to the place of entry. Although the soil around the house is badly infested with termites, the building has been free from them, with the one exception mentioned, since it was built early in 1938.

The oil stays in the ground for a long time and does not diffuse more than a few inches from the little ditches. Apparently it does not affect the growth of shrubs six inches away. No doubt crude oil would give as good results as oil drained from motors.

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HUMBOLDT CURRENT IN 1941

ALONG the west coast of South America and in the Galapagos, there is a generally accepted tradition of a seven-year cycle associated with the Humboldt (Peru) Current. This belief has been shared by many

leading scientists. The terribly destructive rains of 1925, followed by conspicuous, yet less marked phenomena in 1932 and 1939, have lent further support to this theory. But the unexpectedly heavy precipitation of January, February and March of last year, with its direct and indirect effect upon sea and animal life which I observed at the time of the Lima Assembly of the Pan American Institute of Geography and History, apparently has not been noted in scientific literature.

A subsequent search into the scattered and scanty records of known periodic changes in the Humboldt Current has not yielded satisfactory results. The most illuminating record of Peruvian rains, which I have seen, appears in an article entitled "Las Lluvias en Piura,"[1] which summarizes the rains over a hundred-year period. There were six dry intervals of three years each, two of four years each, one eleven-year interval, one nine-year interval, one six-year interval, six two-year intervals, at least twelve one-year intervals and five periods of two or more successive wet years. The most thorough investigation of this region in the 'twenties and 'thirties has been made by Dr. Robert Cushman Murphy.[2]

The earlier records relating to the wet and dry cycles off the Humboldt Current area are probably not so carefully made as the data of the past fifteen years. A lamentable absence of adequate reporting stations is obvious. Yet surely, the rains of 1941 have disproved the existence of the reputed seven-year cycle.

ELIOT G. MEARS

QUOTATIONS

SCIENCE AND WAR

IN the magazine SCIENCE Dr. Peter L. Kapitza, a physicist whose name is identified with brilliant efforts to reach absolute zero, reviews the work done by Russian scientists to improve weapons and to find substitutes for much needed importations. His story parallels that which has been told by American and British scientists. If it departs from the familiar pattern it is because of its insistence on the highly practical character of Russian scientific research. Since science must serve the state in Russia, it has concerned itself with discoveries that can be applied in the factory, on the farm and in the hospital. Though this policy has made it difficult for the theorist to thrive, it is now bearing fruit in the form of highly efficient airplanes, improvements on old surgical procedures and the better utilization of raw materials. Here and in Great Britain it was necessary to mobilize science for the war effort. Russian science was mobilized by the state from the very beginning, so that the change from peace to war research was easy.

Scientists deplore war not only because it diverts attention from the urgency of problems which, if solved, would conquer baffling diseases and shed much needed light on the structure of the universe, the nature of matter, the mystery of life, but also because it exploits science. Dr. Kapitza strikes a different note. As he sees it, science derives much inspiration from war. He makes much of the Haber process for synthesizing ammonia—a process which not only enabled Germany to stave off defeat during the last war but which gave her fertilizers. He might have gone farther. The laws of gravitation were derived from ballistics as much as from swinging pendulums. Studies of the gases liberated when guns are fired gave both chemistry and physics an enormous impetus. Blood banks and the control of typhus came out of war, and so did some of the new techniques for operating on the brain and for repairing head injuries.

It is worth noting that the only institutions where science was systematically taught during the eighteenth century were the artillery schools of France; that the heavy chemical industry was created when Leblanc met an urgent wartime need for soda; that the earliest sewing machine, that of Thimmonier, was first used in making uniforms; that synthetic rubber, synthetic gasoline and the whole coal-tar chemical industry were developed by Germany with an eye on the inevitable British blockade. What gains science may make as the result of the present war no one can predict with certainty. Already it is clear that new plastics of startling properties will be developed, that a healthy synthetic rubber industry will be established, and that new synthetic drugs will take the place of those which we have hitherto extracted from imported plants.—*The New York Times* for April 19.

SCIENTIFIC BOOKS

ORGANIC CHEMISTRY

The Chemistry and Manufacture of Cosmetics. By MAISON G. DE NAVARRE. xix + 745 pp., with numerous illustrations and tables. New York: D. Van Nostrand Co., Inc. 1941. 8.00.

THE book opens with a Foreword by Dean Roland

[1] *Boletin de la Sociedad Geografica de Lima,* Tomo IV, 1894.

[2] *Geog. Rev.,* 16: 26–54, 1926, and 29: 1–33, 1939.

T. Lakey, of Wayne University College of Pharmacy, and concludes with a chapter by Ralph J. Mill on the Federal Food, Drug and Cosmetic Act of 1938 as it relates to cosmetics.

As both a text and a reference work, it should be valuable to all interested in its field, whether as students, technicians, sales organizations or manufacturers. It does not aim to be a cookbook or formulary, but to supply the basic information which will enable any intelligent individual to work out his own formulas, and produce cosmetics which shall serve some useful purpose, be entirely non-toxic and stable, with potent sales appeal, and complying with existing municipal, state and federal regulative legislation.

As the author points out, in the case of both perfumes and cosmetics, what would seem to the layman like wholly negligible infinitesimal minutiae often have a great and wholly unsuspected influence upon the character of the final product. This applies not only to its physical appearance and character, but in highest degree to variations in odor, because our marvelous olfactory equipment is such an extremely delicate analytical instrument. Since nature never standardizes her products, which vary from season to season, with variations of soil, climate, temperature, rainfall, fertilizer, etc., the duplication of results is much more difficult with natural than with synthetic products. The activities of scientists, particularly the organic chemists, are constantly making available new substances of immediate value to the cosmetic industry.

In the Introduction, cosmetics are divided into creams, lotions, powders, make-up, soaps and miscellaneous. Each of these in turn is subdivided into various types. Thus, there are three types of creams —cold creams, vanishing creams and waterfree creams; three of lotions—non-alcoholic with gum, strongly alcoholic with no gum and mildly alcoholic; two types of powders—face powder and miscellaneous; two of soaps—shaving cream and shampoo; four of make-up—eye, lip, cheek and entire face; and miscellaneous types include permanent wave, dental, depilatory, bath, mask, manicure and suntan.

The subject matter of the volume is arranged in ten parts (or chapters). Part I deals with metrology and alligation; Part II with the equipment for small manufacture and cosmetic materials; Part III with fundamental chemical, bacteriological and mycological problems; Part IV with preservatives, antioxidants, corrosion, etc.; Part V with cosmetic colors; Part VI with emulsions; Part VII with the detailed description of the different types of creams, lotions, powders, etc.; Part VIII with the physiology of the skin, scalp and hair; Part IX with the Federal Food, Drug and Cosmetic Act of 1938, as mentioned above; and Part X contains the Appendix (supplementary illustrations, tables and other data), Bibliography and Index.

The usefulness of the book is greatly enhanced by numerous cosmetic formulas, patent digests, illustrations, tables, extensive bibliographies and frequent literature references throughout the text. It is a cyclopedia of information about a business as old as man himself, and which at least the female part of our population will undoubtedly still insist constitutes an "essential industry." Paper, presswork and binding are excellent.

A Brief Course in Organic Chemistry. A Combined Text-book and Laboratory Manual. By REYNOLD C. FUSON, RALPH CONNOR, CHAS. C. PRICE and H. R. SNYDER. x + 248 pp. 6 × 9¼ in. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. 1941. $2.50.

INASMUCH as three of the authors are members of the chemistry staff of the University of Illinois, and the fourth (Connor), although now at the University of Pennsylvania, was trained at the same institution, this book presumably reflects the considered judgment of representatives of one of the best-known and most distinguished departments of organic chemistry in our country. As such, it merits and will receive from other organic chemists a cordial welcome and a careful consideration.

One of the major problems in the preparation of a "brief" course in organic chemistry is the immense amount of material from which the selection must be made, and the improbability that all organic chemists will agree on all the details, either as to the topics chosen or the order of their arrangement. For example, in the matter of the sequence of the chapters, the reviewer feels that, based upon structural considerations, the phenols should follow the alcohols, and the carbohydrates and quinones the aldehydes and ketones, before taking up the acids, amines, amino acids and proteins. The joint authorship of the book under review indicates that four leaders in the field have together worked out the problem, to their own satisfaction at least, and this in itself should carry weight with those considering its adoption for use in introductory lecture and laboratory courses.

As the authors state, "this text has been developed in conducting courses for students of agriculture, home economics, veterinary medicine, pre-dentistry and pre-medicine." The plan of presentation is to introduce as early as possible fundamental concepts and the more important types of compounds, in order that the beginner may acquire a working knowledge of the language of organic chemistry, an early mastery of the elements of the subject and a rapidly increasing grasp of the scope and character of the field.

As stated in the title, the volume is both a lecture

text-book and a laboratory manual. The first 183 pages, covering the lecture portion, is followed by 52 pages of Laboratory Directions and Experiments.

The chapters discussing the theoretical side are devoted, in this order, to (I) Methane and its Derivatives, (II) Saturated Hydrocarbons, (III) Unsaturated Hydrocarbons, (IV) Aromatic Hydrocarbons, (V) Alcohols, (VI) Ethers, (VII) Aldehydes, (VIII) Ketones, (IX) Acids and Derivatives, (X) Optical Isomerism, (XI) Carbohydrates, (XII) Amines, (XIII) Amino Acids and Proteins, (XIV) Phenols, (XV) Quinones and (XVI) Heterocyclic Compounds. These chapters are followed by two dealing with some of the outstanding industrial developments of organic chemistry: (XVII) Industrial Developments in Aliphatic Chemistry and (XVIII) Coal Tar Products. A chapter (XIX) is then assigned to Structure and Valence, and one (XX) to Natural Products.

In the experimental portion, after general laboratory directions, discussions of melting points, boiling points and crystallization, 23 experiments are described in detail, for the preparation of individual or groups of organic compounds, or a study of their reactions, each of these experiments concluding with a list of suggestive and helpful questions. The particular experiments given were selected with special reference to the interests of the groups of students for whom the book is primarily intended.

The scientific repast it offers to beginners is assuredly most attractive and, in those who partake, should arouse a keen appetite for more courses from the same cuisine.

Paper, presswork and binding are excellent.

Organic Analytical Reagents. By JOHN H. YOE and LANDON A. SARVER. ix + 339 pp. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. 1941. $4.00.

THE authors explain that their purpose in writing this book was to furnish an up-to-date bibliography on organic analytical reagents and, based upon the literature thus assembled, to discuss the theoretical aspects of the subject and to suggest further research in this important field.

One of the most promising sources of new and valuable analytical reagents certainly exists in the vast number and illimitable variety of organic compounds. In that domain are to be found specific and highly sensitive reagents for gravimetric, colorimetric and nephelometric determinations; primary standards and indicators for volumetric analysis; pH indicators, buffers, protective colloids, flocculating agents, oxidizing and reducing agents, etc.

The volume consists of two parts. Part I is descriptive and theoretical. Part II consists of Glossary, Bibliography and Index. In Part I, the organic analytical reagents are classified into solvents and wash liquids, substances used in neutralizations, oxidizing agents, reducing agents, indicators, primary standards, acidic and basic salinogenic compounds, photometric aids and substances for the control of adsorption, diazotization and coupling agents, alkaloids and natural products.

First is given a list of all the compounds in each of these categories, arranged according to chemical character. This is followed by separate chapters for each (or several) of these classes, in which the appurtenant reagents are described seriatim and in detail, both as to their properties and their applications.

In Part II there is found a very helpful tabulation of all these various reagents, arranged alphabetically under each chemical element to which they apply, which elements likewise are printed in alphabetical order. This is followed by a Glossary of some 750 organic reagents, and a Bibliography of 2,419 titles. No laboratory procedures are included in the volume.

The book can be cordially recommended as a compact and useful reference work on organic analytical reagents. Paper, presswork and binding are excellent.

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REPORTS

FELLOWSHIPS IN SCIENCE AWARDED BY THE GUGGENHEIM FOUNDATION

EIGHTY-TWO John Simon Guggenheim Memorial Fellowships carrying awards amounting to $196,600 to American and Canadian scholars and creative workers have been announced. In making these appointments the trustees of the foundation adopted a resolution that all these fellows of the foundation should be informed that their use of their fellowships is subject to the requirements of any National Service for which they may be required; and the foundation's position is, further, that if any fellow is required for any National Service in a manner and of a kind such that his fellowship stipend would contribute to the war effort he may use the fellowship funds granted him while doing the work which the Government wants him to do.

This is the seventeenth annual series of fellowship awards by the foundation which was established and endowed by the late U. S. Senator Simon Guggenheim and by Mrs. Guggenheim as a memorial to their son John. More than 1,500 applications were received this year.

The fellowships are granted to research workers,

scholars, artists and others who by their previous work have shown themselves to be persons of unusual ability. Men and women, married and unmarried, of all races and creeds who are citizens or permanent residents of the United States, citizens of Canada and of certain Latin American countries, are eligible on equal terms. The fellows are normally of ages between twenty-five and forty years. The stipends are usually $2,500 for a year.

Since its establishment seventeen years ago the foundation has granted 1,210 fellowships with stipends amounting to $2,488,000.

The trustees of the foundation are Mrs. Simon Guggenheim, Francis H. Brownell, Carroll A. Wilson, Charles D. Hilles, Roger W. Straus, Charles Earl, John C. Emison and Medley G. B. Whelpley.

The Committee of Selection consisted of Dr. Frank Aydelotte, director of the Institute for Advanced Study, *Chairman,* Dr. Florence R. Sabin, of the Rockefeller Institute for Medical Research; Professor Edwin Bidwell Wilson, of the Harvard University School of Public Health; Professor Linus Pauling, of the California Institute of Technology, and Professor Wallace Notestein, of Yale University.

The fellows chosen this year come from twenty-two states and Hawaii, and from two Canadian provinces; and they are members of the staffs of thirty-six educational institutions.

Fellowships awarded in the sciences are:

For Work in Biology

Dr. Thomas Rogers Forbes, instructor in anatomy, the Johns Hopkins University Medical School: Studies of the physiology of reproduction.

Dr. Robert Gaunt, assistant professor of biology, New York University: Studies of the functional control of the adrenal cortex.

Dr. Salvador E. Luria, research assistant in surgical bacteriology, Columbia University: Studies of certain biological and physico-chemical properties of bacteriophage.

Dr. Jane Marion Oppenheimer, instructor in biology, Bryn Mawr College: Studies of the development of structure and function in the central nervous system of fishes.

Dr. Simon Dworkin, lecturer in physiology, McGill University, Montreal: The preparation of a monograph comparing the higher nervous activity of dog, cat and rat, as revealed by the experimental method of conditioned reflexes.

Dr. Charles Leonard Huskins, professor of genetics, McGill University: The preparation of a book on the cytology and genetics of plants, animals and man.

Dr. Floyd Alonzo McClure, professor and curator of economic botany, Lingnan University, Canton, on leave in the United States: The preparation of a book on the Chinese bamboos.

Dr. David R. Goddard, associate professor of botany, University of Rochester: A study of the respiratory enzymes of higher plants.

Dr. John Thomas Curtis, assistant professor of botany, University of Wisconsin: Studies of the ecological status of the "Lake Forest" of Michigan, Wisconsin, Minnesota and Ontario.

Dr. Hugh Carson Cutler, research associate, Botanical Museum, Harvard University: An attempt to determine the location of the area in which corn originated.

Dr. Richard Evans Schultes, research associate, Botanical Museum, Harvard University: Studies of the economic aspects of the flora of southern Colombia and the adjacent part of Ecuador; and an ethnobotanical study of the useful plants, cultivated and wild, among Indian tribes of the same area.

Dr. Rolf Singer, research associate in mycology, Harvard University: Studies of the mycological flora of subtropical America.

Dietrich Bodenstein, research associate in biology, Stanford University: Investigations of the problem of metamorphosis in insects, with special emphasis on the rôle of hormones in development.

Dr. E. Raymond Hall, associate professor of vertebrate zoology and curator of mammals, University of California, Berkeley: Preparation of a monograph on the American weasels.

Dr. Hans Jenny, professor of soil chemistry and morphology, University of California: A study of the relation between nitrogen and organic matter content of soils and annual precipitation in the tropics.

For Work in Geology

Dr. Max Harrison Demorest, instructor in geology, Wesleyan University: Studies of the physics of ice, in particular, studies of the structure and flow of glacial ice.

Dr. George Prior Woollard, geophysicist, Princeton, N. J.: Seismic, gravitational and magnetic investigations of the geologic structure underlying the North American Atlantic coastal plain.

Dr. Wilson Marcy Powell, assistant professor of physics, Kenyon College, will continue his studies of cosmic rays, on the top of Mount Evans, Colorado.

For Work in Anthropology

Dr. Gordon Townsend Bowles, assistant professor of anthropology, University of Hawaii: Studies of functional adaptations in the human skeleton, based on Hawaiian skeletal materials.

Dr. Morris Edward Opler, assistant professor of anthropology, Claremont Colleges: The preparation of a book on the cultures of four related Apache Indian tribes of the Southwest.

For Work in Psychology

Dr. Robert Brodie MacLeod, associate professor of psychology, Swarthmore College: Studies of the psychology of color vision.

Dr. Burrhus Frederic Skinner, associate professor of psychology, University of Minnesota: The completion of a book on the psychology of language.

Dr. Rudolf Arnheim, psychologist, New York City: Studies of the application of the principles and methods of gestalt psychology to art analysis.

FOR WORK IN MATHEMATICS

Dr. John Charles Chenoweth McKinsey, instructor in mathematics, New York University: Studies of the basic concepts and logical foundations of mathematics, and *Dr. Alfred Tarski*, the Polish refugee mathematic Both will work at the Institute for Advanced St Princeton, N. J.

SPECIAL ARTICLES

A NEW PROCEDURE FOR STAINING VAGINAL SMEARS[1]

IN the course of a study of vaginal smears conducted in cooperation with Dr. Herbert F. Traut, of the Department of Gynecology of Cornell Medical College and of New York Hospital, for the purpose of diagnosing malignant tumors and other pathological conditions of the female genital tract,[2] it was realized that certain modifications and improvements in our procedure of staining vaginal smears were necessary. Methods which proved to be successful in other applications[3,4,5] were not found to be entirely satisfactory in this particular work because of a common disadvantage. The staining of the cells was too deep to permit a sharp definition of their outlines in smears that were relatively thick or contained much blood. In most cases of carcinomas and in many other pathological conditions there is a profuse vaginal discharge frequently mixed with blood which forms a heavy film on the slides. In such rich and bloody smears there is considerable crowding and overlapping of cells which, when deeply stained, can not be well differentiated. This applies more particularly to the small endometrial cells which are often found in menstrual and other uterine bleedings and have a pathognomonic value in the diagnosis of adenocarcinomas of the fundus[2] and of other gynecological conditions. These cells also have great imp tance in the evaluation of the normal menstrual cy of sterility and of estrogenic and other endocr therapy.

After long experimentation it was found that much greater transparency and an equally good c differentiation of the cells can be obtained by the u of solutions of stains in 95 per cent. alcohol inst of aqueous solutions. Various alcoholic stains w thus developed, but here only two will be describ which are now being used more generally in our lab ratory (see Table I).

TABLE I

			Stain EA 36	Stain EA 25
Light green SF yellowish	National Aniline and Chemical Co.	0.5 per cent. solution in 95 per cent. alcohol	45 cc	44 cc
Bismarck Brown	National Aniline and Chemical Co.	0.5 per cent. solution in 95 per cent. alcohol	10 cc	12 cc
Eosin yellowish	National Aniline and Chemical Co.	0.5 per cent. solution in 95 per cent. alcohol	45 cc	44 cc
Acid phosphotungstic	Merck		0.200 gm	0.170 gm
Lithium carbonate, saturated aqueous solution			1 drop	1 dr

The 0.5 per cent. alcoholic solutions are first pr pared. As the solubility of the stains in 95 per ce alcohol is low, the solutions are heated at the time preparation. The solutions are kept in stock witho being filtered. Stains EA 36 or EA 25 should, ho ever, be filtered in order to eliminate undissolved pa ticles of stain.

The staining procedure is as follows:

1. Fix smears immediately (before drying) in equ parts of 95 per cent. alcohol and ether for 5 to 15 mi utes.[6] Rinse in 70 per cent. and 50 per cent. alcoh and in distilled water.

2. Stain in hematoxylin for 5 to 10 minutes.[7] Rin

[1] From the Department of Anatomy, Cornell University Medical College, New York, N. Y. Aided by a grant by the Commonwealth Fund.

[2] G. N. Papanicolaou and H. F. Traut, *Jour. Obst. and Gyn.*, 42: 193, 1941.

[3] G. N. Papanicolaou, *Amer. Jour. Anat.*, 52: 519, 1933.

[4] E. Shorr, SCIENCE, 91: 321, 1940; *ibid.*, 91: 579, 1940; *ibid.*, 94: 545, 1941.

[5] G. N. Papanicolaou, *Jour. Lab. and Clin. Med.*, 26: 1200, 1941.

[6] Although smears may be kept in the fixative indi nitely, a prolonged fixation of a week or more affects t staining reaction of the cells.

[7] Staining for only 2 minutes is often sufficient, but, a rule, better results are obtained with longer staini of 5 to 6 minutes for normal smears and of 8 to 10 f smears used for diagnostic purposes, more particularly f cancer diagnosis. For sections, even longer staining advised. This timing applies more specifically to Har Hematoxylin, prepared with domestic hematoxylin a ammonium alum, which is now used in our laborator In order to obtain more uniform staining, used hem toxylin should not be discarded, but filtered from time

distilled water. Rinse 3 to 4 times in 0.5 per cent. aqueous solution of hydrochloric acid. Rinse thoroughly in water. Leave for 1 minute in a weak solution of lithium carbonate (3 drops of a saturated aqueous solution per 100 cc of water). Rinse thoroughly in water.

3. Rinse in distilled water, then in 50 per cent., 70 per cent., 80 per cent. and 95 per cent. alcohols.

4. Stain for 1 minute in the following solution (OG 6):[8]

5. Rinse 5 to 10 times in each of two jars containing 95 per cent. alcohol, to remove excess stain.

6. Stain in EA 36 or EA 25 for 2 minutes.

7. Rinse 5 to 10 times in each of three jars containing 95 per cent. alcohol. (Do not use the same alcohol which was used after Orange G.) Rinse in absolute alcohol and xylol. Mount in Clarite, Canada Balsam or Gum Damar.

The advantages offered by this staining method are the following: (1) The epithelial cells and the erythrocytes are more transparent. Overlapping cells can be more easily differentiated. (2) The color of the acidophilic cells varies from red to orange. This helps in the identification of certain smear types. Basophilic cells stain green or blue-green. (3) Cells or fragments of tissue penetrated by blood take a characteristic orange or orange-green color which permits an easier recognition of small amounts of blood, even when erythrocytes are not distinctly seen. (4) Smears which were subjected to partial or even complete drying can be stained fairly satisfactorily. The differential coloring is not entirely lost.

Stains EA 36 or EA 25 can be used for short staining by those who want to make an immediate examination of a slide. No fixative needs to be used. The slides are dipped directly in the staining solution or covered by stain contained in a dropping bottle. The smears are thus fixed and stained simultaneously within a few minutes, although they may be kept in the stain for a longer time without being overstained. The excess stain is washed off in 95 per cent. alcohol and then the slides are carried through absolute alcohol and xylol and mounted in Clarite. The nuclei are stained faintly, but the cells show good differential staining and retain their transparency. Smears stained by this simple method can be restained by a repetition of the procedure described in this paper, including hematoxylin. This will improve the nuclear staining as well as the cellular differentiation and will permit the use of the same smears for a more detailed cytological study.

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[8] The loss from filtering and evaporation is gradually replaced by the addition of fresh stain.

[9] The addition of phosphotungstic acid to the Orange G solution intensifies the orange color. For normal slides a slight acidification of 0.010 gm per 100 cc (OG 8) or 0.015 gm per 100 cc (OG 6) is suggested. For cancer diagnosis a higher acidification of 0.025 gm per 100 cc (OG 5) is often preferable, as it gives a sharper contrast of the abnormal cell types.

Orange G	National Aniline and Chemical Co.	0.5 per cent. solution in 95 per cent alcohol	100 cc
Acid phosphotungstic	Merck		0.015 gm

FERRITIN AND APOFERRITIN

LAUFBERGER[1] discovered in 1937 an iron-containing protein extracted from horse spleen, containing about 20 per cent. iron. The compound was studied in more detail by Kuhn, Sorensen and Berkofen.[2] Our own investigation was started primarily with respect to the magnetic properties of this compound. In this preliminary note, however, we restrict ourselves to the statement of the result that the iron atom, which is in the ferric state, has a dipole moment of 3.8 Bohr magnetons per g-atom of Fe and thus is probably another representative of those rare ferric compounds with three unpaired electrons of which Pauling and Coryell[3] discovered one in the form of ferrihemoglobin hydroxide (alkaline) methemoglobin and we[4] another in the form of catalase. This note is more concerned with another very remarkable property of ferritin found on the occasion of these studies.

The crystals of ferritin obtained by adding $CdSO_4$ to its solution are, although rather insoluble in pure water, yet easily soluble in 0.5 to 1.0 per cent. ammonium sulfate solution from which they can be recrystallized by addition of $CdSO_4$. The iron in the ferric state is rather stable but can be gradually reduced to the ferrous state by sodium hydrosulfite ($Na_2S_2O_4$, sodium dithionite). When a solution of ferritin is mixed with $Na_2S_2O_4$, a sufficient amount of α, α'-dipyridyl and some acetate buffer of pH 4.6 is added to avoid alkaline reaction, the iron is gradually removed from the protein in the form of the soluble red ferrous dipyridyl complex which can be separated from the protein by dialysis. According to the period of time used for this process one can obtain protein solutions which after addition of $CdSO_4$ within a minute or so yield crystals of the same shape as originally, but more or less decolorized, and finally even quite colorless solutions and crystals. This iron-free protein will be referred to as *apoferritin*. The possibility of obtaining crystals of variable iron con-

[1] Laufberger, *Bull. Soc. Chim. Biol.*, 19: 1575, 1937.
[2] Kuhn, Sorensen and Berkofen, *Ber.*, 73: 823, 1940.
[3] Pauling and Coryell, *Proc. Nat. Acad. Sci.*, 22: 159, 210, 1936.
[4] Michaelis and Granick, *Jour. Gen. Physiol.*, 25: 325, 1941.

tent will explain why the iron analyses of various preparations may differ somewhat from each other. Taking 23 per cent. Fe as the maximum value, one may say that 23 per cent. dry weight of the crystals is iron. On removing Fe^{+++}, one may either imagine their replacement by protons, or their removal in the form of a hydroxide such as FeO(OH). Accordingly, either 23 per cent. or 36 per cent. of the mass of the crystal can be removed without essentially altering the very characteristic crystal shape. One may imagine how large is the volume occupied by non-protein interstices within the crystal lattice made up by the protein part. These interstices may be filled either by water or by ferric hydroxide without any obvious influence on the crystal lattice. One may imagine what amount of "impurities" or non-protein constituents can adapt themselves into the interstices of a protein crystal, and how critical one should be with respect to the homogeneity and "purity" of a crystallized protein. This critical aspect, of course, is not all novel. So, pepsin may be more or less acetylated[5] without influence on the shape of the crystals. Yet the present case shows this phenomenon to an extent unappreciated heretofore.

On the other hand, it would be quite absurd to consider the iron of ferritin simply as a contamination of the protein. Rather may one say that the specific structure of apoferritin is adapted to the task of fixing iron atoms in the ratio of about one half to one Fe to each peptide link, without losing the specific structure. It is easy to understand that the space between the four N atoms of a porphyrin allows one Fe atom to be enclosed without loss of the porphyrin structure, but it is hard to imagine a structure of a protein allowing the building in of iron to that enormous extent as found in ferritin. One can not exclude the possibility that a cluster of many molecules of ferric hydroxide such as are known to represent a micelle of a colloidal ferric hydroxide solution, form a center surrounded by apoferritin molecules, reminding one of the very open structures of the zeolites. Such an assumption would dispense with the necessity of linking almost each peptide group with an Fe atom. Study of the crystal structure may be able to decide this point.

The iron content of ferritin is rather constant, *i.e.*, within 2–3 per cent. Ferritin from a normal horse was compared with that from a horse which had been subjected to many bleedings. Although the yields of ferritin obtainable from the two horses differed by 10:1, the Fe content of the ferritin was the same. At present we have no evidence for the existence of apoferritin as such in the spleen. That ferritin is not an artefact due to the method of preparation can be seen from the fact that the juice of spleen mixed with $CdSO_4$ without any other treatment yields crystals of ferritin.

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THE PRODUCTION OF ANTIBODIES IN VITRO

BY following the general procedure proposed in connection with a theory of serological phenomena we have succeeded in making antibodies in the laboratory.

The procedure consists in subjecting normal globulin or other protein to the action of denaturing reagents or conditions in the presence of an antigen. The protein molecule unfolds, and then refolds in such a way as to assume a configuration complementary to that of the antigen, thus acquiring the properties of a specific homologous antibody.

Bovine γ-globulin was the protein used in most of our experiments. Some success was obtained also with other serum globulin fractions and with serum albumin. As antigens there have been used the trisphenylmethane dye methyl blue (a mixture of the *p*-trisulfonated and disulfonated triphenylpararosanilines), the azo dye 1,3-dihydroxy-2,4,6-tri(*p*-azophenyl-arsonic acid) benzene, and pneumococcus polysaccharide type III. Successful experiments were made by addition of alkali (to pH 11) and slow return to neutrality, by addition and slow removal of urea, and by heating to about 65° and slowly cooling; some success was also obtained by surface denaturation. The most satisfactory of the treatments tried was that of holding a solution of protein and antigen for several days at about 57°; this temperature seems to be high enough to cause the protein chains to unfold and to refold under the influence of the antigen into specific complementary configurations.

In one experiment a solution containing 0.01 per cent. of the azo dye mentioned above and 1 per cent. of bovine γ-globulin was held at 57° for about 10 days, then removed from the bath, and dialyzed through Cellophane against 1 per cent. salt solution. Some precipitate formed during the heating and more during the dialysis. The mixture was then dialyzed against a 1 per cent. solution of the haptene arsanilic acid, which was changed several times. Most of the precipitate dissolved during this dialysis; that which remained was discarded. The solution, which was free of dye, was then dialyzed against 1 per cent. salt solution to remove the haptene.

[1] L. Pauling, *Jour. Am. Chem. Soc.*, 62: 2643, 1940.

[5] Northrup, "Crystalline Enzymes," Columbia University Press, 1939.

The resulting protein solution was found to have many properties of an antiserum specific to the phenylarsonic acid group. It gave precipitates with multihaptenic dyes and azoproteins containing this group, and not with other dyes or azoproteins, and the specific precipitates were dissolved by excess of dyes or haptenes containing this group but not by other dyes or haptenes, such as those containing the phenylsulfonic acid group.

A solution of 1 per cent. pneumococcus polysaccharide type III and 1 per cent. bovine γ-globulin was similarly held at 57° for 14 days. Some precipitate formed, which was removed. The resultant solution was found to precipitate type III polysaccharide but not types I or VIII (cross-reaction with type VIII was thus not shown) and to agglutinate pneumococci type III but not types I or II. Purified antibody solutions were made by adding 15 per cent. salt and bringing to pH 4 or adding 15 per cent. salt, calcium chloride, and calcium hydroxide to pH 8, thus precipitating polysaccharide and some protein. Each of the two solutions, after dialysis against 1 per cent. salt solution, was found to precipitate type III polysaccharide but not types I or VIII and to agglutinate type III pneumococci but not types I or II. Mouse protection tests and swelling tests have not yet been carried out.

We acknowledge with thanks the support of a grant from the Rockefeller Foundation, the assistance of Dr. David Pressman, and the courtesy of Dr. W. Goebel in providing material.

Our experiments are being continued.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE USE OF THE COMPLEMENT FIXATION TEST IN ROCKY MOUNTAIN SPOTTED FEVER

THE clinical differentiation between typhus fever and Rocky Mountain spotted fever may be difficult, especially when both diseases occur in the same region. The laboratory diagnosis may be made by the isolation of the virus from the patient, but this can only be satisfactorily performed if guinea pigs are inoculated immediately upon withdrawal of the blood. The agglutination test, using either typhus or Rocky Mountain spotted fever Rickettsiae is not satisfactory, while the Weil-Felix agglutination with Proteus OX 19 may indicate the presence of a Rickettsial disease, but a differentiation between typhus and Rocky Mountain spotted fever can not be made. It is for these reasons that a specific complement fixation reaction may be of value in distinguishing these two diseases.

Castaneda[1] prepared an antigen from the peritoneal washings of x-rayed rats inoculated with endemic Rickettsiae and reported positive complement fixation in typhus fever. Bengtson[2] described a specific complement fixation reaction for "Q" fever and endemic typhus, using an antigen prepared with Rickettsiae grown in the yolk sac of developing chick embryos (Cox method).[3] No satisfactory antigen for Rocky Mountain spotted fever had previously been prepared and it is the purpose of this communication to describe a specific complement fixation test which may be used in this disease.

The sera used in the tests were obtained from recovered human cases of Rocky Mountain spotted fever, "Q" fever and Brill's disease and from guinea pigs recovered from infections with Rocky Mountain spotted fever, endemic typhus, European typhus and "Q" fever. As controls, human sera were obtained from several different febrile diseases, strongly Wassermann positive sera, as well as normal sera. Likewise, normal guinea pig sera were used.

Two antigens, which were equally satisfactory, were prepared from tissue cultures grown by the semi-solid agar method in Kolle flasks.[4,5] The cultures were initiated with infected guinea pig spleen and grown in contact with ten-day chick embryo cells. Transplants were made every seven days by scraping off the infected cells from the surface of the medium and grinding in a tube with alundum. This material was again brought in contact with normal chick embryo cells. After several transplants, the cultures became exceedingly rich, so that a considerable number of Rickettsiae were seen in every field. The antigens employed were made from the 25th to the 35th transplant. Five cubic centimeters of a 1:10,000 merthiolate solution in saline was used to wash off the cells from each Kolle flask. When a certain amount of material was obtained, the Rickettsiae were extracted in the following manner. One batch was ground up in the Waring Blender and then frozen and thawed five times. The other was shaken in a large Pyrex flask with glass beads. The Rickettsial suspensions were then centrifuged in an angle centrifuge at 1,500 r.p.m. for 30 minutes. The supernatant fluid was removed and centrifuged at 4,500 r.p.m. for one hour. The sediment was then resuspended in 0.85

[1] M. Castaneda, *Jour. Immunology*, 31: 285–291, 1936.
[2] I. Bengtson, *Proc. Soc. Exp. Biol. and Med.*, 46: 665–668, 1941; *Pub. Health Reports*, 56: 649–653, 1941; *Pub. Health Reports*, 56: 1723–1727, 1941.
[3] H. R. Cox, *Pub. Health Reports*, 53: 2241–2247, 1938.
[4] Zinsser, Fitzpatrick and Wei, *Jour. Exp. Med.*, 69: 179, 1939.
[5] Zinsser, Plotz, Enders, SCIENCE, 91: 51–52, 1940.

per cent. saline to one fifth of the original volume. The final preparation contained a heavy suspension of Rickettsiae.

The antigen was titrated with a known guinea pig serum as well as with two known human sera. A 4 plus fixation was obtained with dilutions of the antigen up to 1:6. The antigen was found to be anti-complementary in a dilution of 1:2. An antigen dilution of 1:4 was used in all tests.

The usual hemolytic system, consisting of sheep cells, guinea pig complement and rabbit anti-sheep cell amboceptor was employed. The amboceptor was diluted to contain 3 M.H.D. in 0.25 cc. Equal amounts of amboceptor dilution and a 3 per cent. suspension of sheep cells were mixed together. The fresh complement was titrated on the day of the test.

Sera were inactivated at 56° C. for 30 minutes. Serum dilutions were made ranging from 1:3 to 1:192 using 0.25 cc amounts of each dilution in the test. Complement was diluted to contain 2 full units in 0.5 cc. A suitable antigen dilution was added in 0.25 cc amounts. Fixation was carried out for 20 hours in the ice box (4° C.) following which 0.5 cc of sensitized sheep cells were added to each tube and incubated for 30 minutes at 37° C. One and two units of complement in the presence of 0.25 cc of antigen dilution were also set up to indicate the validity of the results by showing the actual amount of free complement at the time the hemolytic system was added. The results of the tests are shown in Table 1.

TABLE 1

Human sera	Date of illness	Disease	1:3	1:6	1:12	1:24	1:48	1:96	1:192	Serum control
RO	1941	R.S.F.	4	4	4	4	4	2	1	0
WE	1938	R.S.F.	4	4	4	3	2	0	0	0
PA	1940	R.S.F.	4	4	3	2	1	0	0	0
SH	1941	R.S.F.	4	4	4	4	4	3	2	0
SM	1940	R.S.F.	4	4	4	4	3	2	1	0
RA	1941	R.S.F.	4	4	4	4	4	2	1	0
HO	1941	R.S.F.	4	4	4	4	4	4	2	0
HU	1937	R.S.F.	4	4	3	2	–	–	–	0
LO	1941	R.S.F.	4	4	4	4	3	2	–	0
2 cases		Brill's	0	0	0	0	–	–	–	0
11 sera		Various febrile cases	0	0	0	0	–	–	–	0
8 sera		Wassermann positive	0	0	0	0	–	–	–	0
2 sera		"Q" fever	0	0	0	0	–	–	–	0
11 sera		Normal	0	0	0	0	–	–	–	0

We have examined the sera from nine cases of Rocky Mountain spotted fever and obtained positive complement fixation reactions in all. The oldest case (HU) had the disease 4½ years prior to the examination of the serum, while the most recent serum (LO) examined was obtained on the 12th day of illness. This latter finding is significant, for if in subsequent cases it can be shown that antibodies can be demonstrated so early in the disease the complement fixation test may prove to be a real aid in diagnosis. In three cases, (PA), (SH) and (SM), several specimens of serum were examined over a period of three and six months and no significant change in titre was noted.

There were two cases where the possible diagnosis of typhus fever was made. The subsequent course of the disease, a negative fixation test for typhus fever and a positive test for Rocky Mountain spotted fever indicated that we were dealing with the latter disease.

TABLE 2

Guinea pig sera	Disease	1:3	1:6	1:12	1:24	1:48	1:96	1:192	Serum control
No. 761	6 days after drop Temp.	0	0	0	0	–	–	–	0
" 743	12 days after drop Temp.	4	4	3	3	2	0	0	0
" 379	R.S.F.	4	4	4	4	3	1	0	0
" 489	R.S.F.	4	3	3	2	1	–	–	0
" 277	R.S.F.	3	3	2	1	1	–	–	0
" 220	R.S.F.	4	4	4	4	3	1	0	0
" 486	R.S.F.	4	4	4	4	3	2	0	0
" 498	R.S.F.	4	4	4	3	1	0	0	0
" 490	R.S.F.	3	2	2	1	–	–	–	0
7 sera	Endemic	0	0	0	0				0
6 sera	Epidemic	0	0	0	0				0
3 sera	"Q" fever	0	0	0	0				0
15 sera	Normal	0	0	0	0				0

In guinea pigs (Table 2), fixation was obtained with eight sera. It is of interest to note that one guinea pig gave a negative reaction six days after the return of temperature to normal, while another gave a positive test after twelve days. The occurrence of fixing antibodies during the course of the illness in guinea pigs and monkeys is now being studied. No fixation was obtained with sera from endemic typhus, epidemic typhus or "Q" fever.

The results obtained in the tests described indicate that the complement fixation test may be employed in diagnosing Rocky Mountain spotted fever.

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SCIENCE NEWS

Science Service, Washington, D. C.

SOME PAPERS READ BEFORE THE MEMPHIS MEETING OF THE AMERICAN CHEMICAL SOCIETY

MORE than 3,000 of the nation's leading chemists gathered at Memphis, Tennessee, for the annual meeting of the American Chemical Society. Reports of the latest progress were embodied in well over 300 papers, covering all phases from the newest things in plastics to the most potent of recently developed sulfa drugs.

The meeting, like those of practically all other scientific organizations this year, was frankly incomplete because of the war. Many chemists had been unable to attend because research connected with the war effort would not permit them to be absent from their laboratories for even a few days, and many of those who were able to be present were anxious to get back to their jobs as soon as possible.

Some of the most important chemical discoveries made in recent months can not be disclosed even to professional colleagues because their military value imposes the necessity of strictest secrecy. Obviously nothing that has to do with explosives or chemical warfare methods can be given publicity at this time, and there are many things in the fields of metallurgy, plastics, fuels, etc., that must be left unsaid. This secrecy is uncongenial to scientific men, who by tradition are accustomed to frank disclosure of their discoveries as soon as they are properly checked and confirmed; "mais, c'est la guerre."

There are, however, even some wartime phases of chemistry that can properly be brought into the open. One leading paper in the opening session on Monday afternoon was entitled "The Chemist's Place in Civilian Defense," presented by Col. A. Gibson, of the Chemical Warfare Service. The paper was followed by a film showing how incendiary bombs should be fought, issued by the Office of Civilian Defense. Another paper, "Cotton—Yesterday, To-day and To-morrow," by Dr. Henry G. Knight, of the U. S. Department of Agriculture, pointed out cotton's contributions to the war effort, all the way from soldiers' clothes and tents to the making of guncotton and smokeless powder.

To supply eventually industrial alcohol demands now running 300 per cent. above normal because of the war, chemists are offering three research achievements:

1. Discovery of how to break down non-fermentable sugars in corn, wood and paper mill waste liquors by means of enzymes produced by fungi, may lead to a new industry producing needed alcohol from hitherto unused materials. Professor Frederick F. Nord and John C. Wirth, of Fordham University, reported the production for the first time of pyruvic acid, a heavy syrupy substance, from pentose, which is an intermediate step in the production of alcohol. 2. Demonstration that the common bread molds can be used in converting grain into alcohol, with greater speed, economy, and efficiency than the customary malt from sprouting barley. Drs. L. A. Underkofler, Lu Chen Hao, and Ellis I. Fulmer, of Iowa State College, stated that this "mold-bran," used to substitute for malt in saccharifying corn and other mash, promises to eliminate any bottleneck in the expanded grain alcohol industry. Use of the molds in alcoholic fermentation of 100,000,000 bushels of corn or wheat would give about 25,000,000 more gallons of alcohol than would be obtained with malt. 3. Development of a continuous fermentation process for molasses that makes one apparatus do the work of ten. H. R. Bilford, R. E. Scalf, W. H. Stark and Paul J. Kolachov, of the Seagram laboratories, Louisville, Ky., have succeeded in speeding the fermentation cycle from 50 hours to 5 hours, by making the process continuous instead of in batches. The first two of these new developments are expected to have an effect upon the sugar shortage, because they produce alcohol in larger quantity from grain instead of sugar or molasses. The importance of the Fordham discovery is that yeast, used to break down fermentable sugars, chief current source of industrial alcohol, attacks non-fermentable sugars without effect. As a result the non-fermentable sugars, which exist side by side in corn, wood, or paper mill waste liquors with the fermentable sugars, have been ignored in alcohol manufacture for want of an attacking agent. Sugar is an energy supplier and by utilizing the C_5 chain—a compound of five carbon atoms present in non-fermentable sugars—a new source of energy could be obtained. Dr. Nord and Mr. Wirth utilized certain mineral foodstuffs in cultivating the fungi that successfully attack the non-fermentable sugars, or pentose. Through this agent it was possible to isolate pyruvic acid in large amounts as an intermediate, or go-between, in the formation of alcohol from pentose. The isolation of pyruvic acid provides the clue concerning the sequences of the phases of conversion of pentose to alcohol.

A chocolate-flavored syrup of germs that, according to preliminary tests, enables human beings to eat grass, leaves and wood if other food supplies fail was announced by Dr. Gustav J. Martin, of the Warner Institute for Therapeutic Research, New York City. The germ syrup, which would accomplish the desired result for a lifetime at a cost of $2 per person, is considered particularly suitable for paratroops and other army units. It seems to be the American research scientist's answer to reports that the Germans have developed a similar procedure for enabling their soldiers to live on wood, leaves or grass. For civilians as well as soldiers, a germ syrup to supply vitamins for a lifetime is also on its way, if Dr. Martin's experiments prove successful. Certain bacteria, or germs, of a type that do not cause disease, are known to manufacture various of the B vitamins. The cow does not have to eat B vitamins in food because her rumen contains the bacteria that manufacture them. Dr. Martin's experiments are designed to develop similar germ vitamin factories in man's intestines. Dr. Martin's work on developing germ vitamin factories and the chocolate-flavored germ syrup for digesting grass, leaves and wood has been done on laboratory animals. Preliminary tests on humans have been started in New York hospitals, but have not gone long enough for conclusive results to be reported.

The idea of creating germ vitamin factories in man's body to make him independent of food sources of vitamins or even of vitamin pills resulted from the discovery that one of the B vitamins, pantothenic acid, can stimulate the growth of those intestinal tract germs which synthesize another B vitamin, inositol. In past experiments when pantothenic acid was left out of the diet, the symptoms that resulted, such as hair graying and hemorrhage of the adrenal glands and so on, were attributed to the lack of pantothenic acid. But because there was no pantothenic acid in the diet, there was also an unsuspected deficiency of inositol. It was this unsuspected lack of inositol that was responsible for some of the symptoms attributed to lack of pantothenic acid. Graying of the hair, Dr. Martin reported, is actually due to pantothenic acid deficiency and inositol will not cure the condition. The adrenal hemorrhages, however, are due to the inositol deficiency. Lack of pantothenic acid, Dr. Martin pointed out, is not the only dietary lack which will produce gray hair. Restoring hair color lost through lack of pantothenic acid may be accomplished by restoring pantothenic acid to the diet. Hair color may also be restored, as has previously been reported, by doses of another vitamin para-aminobenzoic acid. This vitamin acts to "cure" gray hair, Dr. Martin is now convinced, through its action on bacteria in the intestinal tract.

A revolution in paints, varnishes and lacquers is in the making, comparable with the great and rapid changes wrought a few years ago by the introduction of cellulose lacquers, which made the world a decidedly brighter place to live in. The new revolution in protective coatings is being brought about by a new class of solvents, known as the nitroparaffins, which were described by Dr. Charles Bogin and Dr. H. L. Wampner, of Commercial Solvents Corporation, Terre Haute, Ind. The nitroparaffins are made by treating one constituent of natural gas, propane, with nitric acid. There are four of them, known, respectively, as nitromethane, nitroethane, 1-nitropropane and 2-nitropropane. They are all excellent solvents for a number of coating materials, including the cellulose compounds, the rubber-like vinyl compounds, rubber itself, and natural shellac. From the user's point of view they recommend themselves in several ways. They have only a little odor, and that not disagreeable, contrasting favorably with some of the solvents in present use. They are less inflammable than many of the present solvents, and are relatively non-toxic. They dry out at a moderate rate, permitting ready spreading, but not staying wet too long after application. Finally, they permit less complex mixing formulas, so that costs of production should be lower.

A discovery that should have the doubly desirable effect of reducing the cost of one of the most important vitamins and at the same time finding a use for what is now one of the most nearly useless of dairy by-products was reported by Dr. A. Leviton, of the Bureau of Dairy Industry, U. S. Department of Agriculture. He has found that when whey is being condensed to the point where crystals of milk sugar begin to form, the vitamin riboflavin is strongly adsorbed on them. A concentration of as much as 300 micrograms of riboflavin per gram of milk sugar has been prepared in the laboratory.

"Dated" vitamins may presently become necessary, a result of the discovery that oxygen is an enemy of vi min D. This discovery was reported by Dr. J. C. Fr Dr. J. L. Halpin, Dr. J. H. Hooper and Dr. E. H. Kram of Borden's Nutritional Research Laboratory, Elgin, They found that vitamin D, both natural and synthe deteriorated on standing, and have evidence that oxyg in the air was the cause of the mischief. They were a to protect the vitamin by applying protective coatings the substances on which it was adsorbed, or by plac it in containers in which air had been replaced by inert gas.

It was pointed out by Dr. Gustav Egloff and P. M. V Arsdell, of the Universal Oil Products Company Resea Laboratories, that the enemy Axis, sadly lacking in manages to creak along on its destructive path despi its oilless state. "At the end of 1941," they stated, was estimated that there were 107,225 compressed g vehicles which released approximately 2,553,000 barr of liquid fuels, and a maximum of 373,143 producer g vehicles in use in Europe, which saved about 7,780,0 barrels of oil fuel. Approximately 13,200,000 barrels benzol and alcohol were produced on the European con nent in the same period and 233,000 barrels of shale also had been produced. Sweden and Spain planned produce greater quantities of shale oil from their und veloped resources. The cataloguing of the other subst tutes shows that man has availed himself of animal, veg table, and mineral products to run his motor vehicles all the continents of the world. The only energy give so far untapped for direct use in a motor are sunlight a atomic power, and the chances are that when human in genuity can rise to the occasion, even these, too, will b used."

That nicotinic acid, the vitamin that saves lives by pr venting and curing the disabling "hard times disease," pellagra, can work harm as well as good, has been show in experiments reported by Professor Jakob A. Stek of the Vanderbilt University School of Medicine. He fe young male rats on a synthetic diet short in casein, o of the important protein foods. At the same time he gav them enough nicotinic acid to make up one per cent. their rations—far more of this vitamin than goes into th normal diet of either human beings or any experiment animal. The rats' growth was stunted. Curiously enoug parallel treatment of young female rats had no effect their growth.

A literal case of poison against poison was reported b A. L. Moxon and H. D. Anderson, of the South Dako Agricultural Experiment Station. In parts of the Nort west, selenium poisoning is a serious problem in the liv stock industry. The poisonous element exists in the so gets into plants which the animals eat, and cripples sometimes kills them. In careful experiments, Mr. Mox and Mr. Anderson have found that selenium poisoni can be stopped by giving the animals very small amoun of arsenic, in their food or drinking water, or in the sa which ranch cattle eagerly seek. Concentrations as lo as 12 to 25 parts per million were found effective in th treatment of dogs, chickens and cattle.

Lead is commonly rated as one of the worst poisons a person can swallow. Yet we all eat and drink lead daily and come to no harm from it, according to Dr. Robert A. Kehoe, of the Kettering Laboratory of Applied Physiology at the University of Cincinnati. The secret of this apparent paradox lies in the exceedingly small amounts we take in—on an average only about three milligrams a day. (A milligram is a thousandth of a gram, and a gram is about a thirtieth of an ounce.) Lead gets into our food and water from the common rocks and minerals of the earth's surface, many of which contain it in small quantities.

We commonly think of carbon dioxide as the gas that makes some of our favorite beverages fizz, or (in its solid form) as the exceedingly cold stuff that keeps ice cream frozen as we take it home. This versatile gas has been found useful in another connection, by Dr. Philip W. West, of Louisiana State University. It is an advantage in making artificial ice to use as low temperatures as possible in freezing the water. The trouble is, however, that sometimes ice frozen at very low temperatures has a tendency to crack or shatter. He has found that by running a small amount of carbon dioxide into the water it is possible to drop freezing temperatures by as much as five degrees Fahrenheit, resulting in an increase of the ice yield of the plant by nearly a third. The extra cost of the carbon dioxide was insignificant.

Chilean copper, vital for victory, is the product of tremendous natural convulsions in the earth in an age long past, was stated by Dr. Nancy Brower, of Mary Hardin-Baylor College. The place where it is produced, known as the Chuquicamata mine, is a tremendous open pit, like the great iron mines in northern Minnesota. It is claimed to be the largest open-pit copper mine in the world. It is situated on the west slope of the Andes, about 10,000 feet above sea level, approximately 150 miles northeast of the city of Antofagasta. The most plausible theory for the presence of copper ore there is that strong volcanic action in the remote past carried the copper ore in solution up into the veins where it now occurs and concentrated it there. This theory gains support, Dr. Brower pointed out, through the presence in the neighborhood of two volcanoes still active. She was able to set forth her facts with first-hand intimacy, because she lived practically on the rim of the mine all her life until three years ago.

Hundred-octane gasolines, which give great advantage in battle to American and Allied planes, are specially tailored fuels, according to Dr. Hulit Madinger, of the Colorado Polytechnic Institute. He described two processes by which separate constituents are chemically stitched together. Both processes belong to the general class known as alkylation, but one is conducted with a catalyst and is known as catalytic alkylation; the other is carried out by heat alone and is known as thermal alkylation. In the catalytic alkylation, the common and cheap chemical, sulfuric acid, serves as catalyst. The two constituent carbon compounds, isobutane and butylene-1, are subjected to mild pressure and relatively low temperature over the acid, and they emerge as high-grade 100-octane fuel. In the other process, isobutane and ethylene are united by subjecting them to quite high pressures, at temperatures as high as 1,400 degrees Fahrenheit.

A series of new sulfa drugs was described by Dr. Simon L. Ruskin, of New York. His objective was to combine the sulfa group of atoms, which has such remarkable knock-out powers against certain bacteria, with atom groups occurring naturally in the body, such as the building-blocks of some of the proteins. He anticipated the result that these new compounds should be less poisonous to the patient than some sulfa drugs now in use, while at the same time they would retain their power against the enemy microorganisms. Preliminary experiments indicate that he has had a considerable degree of success. The new compounds must, however, be subjected to further testing before they can be offered to the medical profession for general use.

It seems a far cry from the modern age of chemistry to the days of Solomon in his glory; yet learned men in Bible times did possess and use a practical working knowledge of certain chemical processes, was pointed out by Professor John T. Chappell, of Marion College. Even as early as the time of Moses, about 1500 B.C., a considerable amount of chemical knowledge entered into the metallurgy of the gold, silver and copper used in constructing the Tabernacle and its fittings. Five hundred years later, when Solomon built the Temple and his great palace, and had fleets on the sea, a further development of the chemical industries had taken place.

Thermometers use the boiling point of water (100 degrees Centigrade, 212 degrees Fahrenheit) as the landmark from which they start making their scales. Another fixed point, more accurately determinable, was offered by Dr. Frank W. Schwab and Dr. Edward Wichers, of the National Bureau of Standards. It is the freezing-point of benzoic acid, a rather common chemical. This passes from liquid to solid state at 122.37 degrees Centigrade. The temperature never varies more than a thousandth of a degree, and is independent of barometric pressure, which is a troublesome variable in determining the steam-point of water.

Sugar as the basis for many chemical processes has many advantages because of its high degree of purity, according to Dr. E. Whitman Rice, of the National Sugar Refining Company. Ordinary white sugar, as it comes to the table, is purer than many chemical compounds officially rated as "chemically pure." Use of such a material in industrial operations will do away with many costly refining and purifying processes necessary with other materials, the speaker pointed out.

Satisfactory composition cork, now widely used as a gasket material for liquid-filled electrical apparatus, can be picked by one simple test, L. P. Hart, Jr., R. W. Work, L. T. Irish, and M. A. Howe, of General Electric, Pittsfield, Mass. To keep the liquid in and also prevent moisture from penetrating, it must be nonporous, and have the proper compressibility, flexibility and density. To test all these properties in composition cork from different sources takes too long. So the engineers use a simple density measurement which tests show is sufficient.

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